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CANCER OF THE EYELIDS

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Cancer of the eyelids may properly be considered as a subtype of cancer of the skin of the face. Its special significance lies in the fact that, unlike other cancers of the skin, it is particularly likely to result in serious impairment of a vital function, namely, that of vision. Such impairment may result either from direct invasion of the eye by the disease or from the effects of treatment by any method employed in an attempt to eradicate the growth completely. In the general group of tumors of the skin, cancer of the eyelids is therefore one of the most important from the standpoint of treatment.

DEFINITION

As anatomic structures, the eyelids do not possess well defined limits or boundaries. Lesions which arise on the skin between the upper and the lower orbital margin and those which in early stages involve either canthus definitely come within the classification of cancer of the eyelids. An adjacent cancer of the skin may invade the eyelids by direct extension, or in some instances the growth arises directly in one of those zones which constitutes the ill defined junction between the eyelids and the skin of the cheek, nose, temple or eyebrow. The exact classification of many lesions of the skin of the upper portion of the cheeks or of the bridge of the nose must therefore be rather arbitrary—a relatively unimportant consideration, except from the standpoint of statistics. In the present study no attempt has been made toward great accuracy of classification in regard to the exact origin of the growth, since from the practical standpoint it has been considered sufficient that the lesion arose near enough to the boundaries of the eyelids to involve those structures in an early stage of the disease. The clinical material on which the statistics of this study are based consists of a series of 147 cancers of the eyelids treated at the Memorial Hospital between 1925 and 1935.

Read before the meeting of the Eye, Ear, Nose and Throat Section of the New York State Medical Society, May 10, 1938.

ETIOLOGY

Age and Sex Incidence.—The average age of the patients on admission was about 54 years. Men were more often affected (57 per cent) than women (43 per cent), with no significant difference in the average ages of the two sexes. The disease appears to be most common in the sixth decade and uncommon below the age of 40 (10 per cent), but several cancers in this series occurred in persons under the age of 30 (fig. 1).

Topographic Distribution.—Of the whole group of cancers of the skin of the face treated during the aforementioned ten year period

Fig. 1.—*A*, multiple basal cell carcinomas of the skin of the face and of both the upper and lower eyelids in a man aged 28. The obvious causative factor was overexposure to sunburn. The patient had never worn a hat. *B*, healed condition of both eyelids after treatment by a combination of low voltage roentgen irradiation and radon seeds. Surgical excision is contraindicated for such multiple lesions.

(excluding those of the scalp and skin of the neck), cancers of the eyelids comprised about 13 per cent. The skin of the nose, most frequently involved, although about the same in surface area as that of the eyelids, gave rise to cancer about three times as often (33 per cent of the whole group). Next to the nose, the eyelids seem to be more commonly involved by cancer than any other area of the skin of the face comparable in size. The lower eyelid and the inner canthus are by far the most frequent sites of origin, while the outer canthus is seldom

involved primarily. The conjunctiva rarely gives rise to cancer, although it may be involved by extension. The topographic incidence of cancer of the eyelids follows:

Lower eyelid	54%
Inner canthus	28%
Upper eyelid	13%
Outer canthus	5%

Causative Factors.—When cancer of the eyelids arises as the result of chronic irritation, it is commonly associated with multiple growths of other parts of the skin of the face. The chronic irritation usually occurs in a combination of forms—the natural aging process of the skin, the long-continued or repeated overexposure to sunburn and weather and the inadequate cleansing by soap and water, especially in the case of mechanics or other laborers whose faces habitually become soiled with mineral dust, ashes, grease or oil. Precancerous keratoses and cancer of the skin of the face frequently occur in women who mistakenly attempt to preserve their complexions by a rigid abstinence from the use of soap and water in their facial toilets.

Any condition of the eyes accompanied by a chronic discharge is likely to produce sufficient chronic irritation of the skin of the lower lids to result in cancer, although the relative incidence from this cause alone has been slight in the head and neck clinic at the Memorial Hospital. In many instances cancer of the eyelids arises as a single lesion in otherwise normal tissues without any apparent etiologic factor.

SYMPTOMS AND CLINICAL COURSE

In the majority of cases, the disease begins on the skin of the eyelids near to but distinctly separate from the palpebral margins. Initial involvement of the palpebral margins may occur, especially at the inner canthus. The lesion usually begins as a small moundlike nonulcerated nodule which infiltrates the skin but is movable with it over the underlying tissues (fig. 2). As the nodule enlarges, a close examination often reveals an apparent pearly translucency, as though a drop of liquid petrolatum had been injected subcutaneously. At this time another characteristic feature frequently appears—a faint telangiectasia over the surface. Ulceration of the surface as a rule occurs when the growth has reached a diameter of 5 or 6 mm., although basal cell carcinoma may reach a size of 1 cm. or more with an intact overlying skin. When the growth arises in an area of keratosis or dermatitis or when it occurs on the palpebral margin, ulceration is commonly present almost from the beginning.

There are few if any subjective symptoms until the lesion has reached a size of 8 to 10 mm. or until it has involved the palpebral margin,

the conjunctiva or the inner canthus. Pain or marked discomfort are never prominent symptoms and are always absent until there are wide ulceration and sepsis. As the growth enlarges, it invariably ulcerates and may then pursue one of several courses. It may grow outward from the lid to produce a bulky fungating tumor (figs. 3, 4 and 5), or it may erode the entire free portion of the eyelid without reaching any great bulk and without deeply invading the orbital cavity (fig. 6). In other instances the tumor may deeply invade the orbital cavity without

Fig. 2.—*A*, basal cell carcinoma of moderate size on the lower eyelid. *B*, healed condition after treatment by the insertion of gold seeds totaling 6.24 millicuries. Such lesions can be treated by surgical excision and skin grafting, but irradiation is more conservative and undoubtedly preferable.

Fig. 3.—*A*, basal cell carcinoma arising just above the inner canthus. *B*, healed condition after removal of the lesion by endothermy and the application of 4,500 roentgens of low voltage unfiltered roentgen irradiation at 100 kilovolts to the base through a portal 2.5 cm. in diameter.

marked ulceration or erosion of the lid (fig. 7). If the inner canthus is involved (fig. 6), epiphora commonly results, due to obstruction of the puncta or canaliculi. The globe itself is resistant to invasion by direct extension of the growth, a complication which rarely occurs, even in the later stages of the disease.

If untreated, basal cell carcinoma of the eyelids tends to run a long chronic course, and the patient may survive ten to twenty years or even more before succumbing to complications resulting from deep inva-

Fig. 4.—*A*, moderate-sized basal cell carcinoma arising in the inner canthus. *B*, healed condition after treatment by the implantation of radon gold seeds totaling 13.44 millicuries. Irradiation is the preferable method of treatment in such cases.

Fig. 5.—*A*, bulky, fungating basal cell carcinoma of the lower eyelid. *B*, healed condition four months after treatment by a combination of high voltage and low voltage roentgen irradiation. *C*, immediate postoperative condition after plastic repair of the defect in the lower eyelid by Dr. A. B. Reese. *D*, final healed condition.

sion of the orbit and periorbital tissues, erosion of bone and intracranial extension of the growth. Squamous carcinoma tends to run a shorter course; if it is not controlled, death commonly occurs from metastases.

Fig. 6.—*A*, extensive carcinoma arising at the junction of the lower eyelid and the cheek and deeply invading the inner canthus and eroding the lower eyelid. *B*, lead shield with an aperture for low voltage roentgen irradiation. *C*, healed condition after application of a total of 4,300 roentgens of unfiltered roentgen irradiation at 100 kilovolts through a portal 10 cm. in diameter over a period of three weeks. A postirradiation cataract has developed.

Fig. 7.—*A*, squamous carcinoma which has eroded the lower eyelid and extended deeply into the floor of the orbit. The deep extension and radioresistance of this lesion make its control by irradiation improbable. *B*, healed condition after exenteration of the orbit by means of cautery.

Extension to the lymph nodes usually takes place, first to the corresponding preauricular lymph node, and next to the upper and lower deep cervical lymph nodes.

DIAGNOSIS

The possibility of cancer should be considered when any tumor of the eyelid is present, whether it is ulcerated or not. The existence of a chronic ulcer or ulcerated tumor on the eyelids may be considered as diagnostic of cancer. As has been previously mentioned, however, basal cell carcinoma in this region may reach a size of 8 to 10 mm. with little or no surface ulceration. Fixation in the skin, a pearly white or pinkish translucent appearance and faint telangiectasia in the overlying skin are always suggestive of basal cell carcinoma.

Malignant Melanoma.—This growth may occur on the eyelids either as a single lesion on the skin or as a part of a diffuse melanosis of the skin and conjunctiva. When it occurs as a single lesion of the skin of the eyelids, it resembles melanoma of the skin in general. One of its most characteristic though not infallible signs is a bluish or brownish black pigmentation in a raised, indurated and nonulcerated tumor. Pigmentation may also occur in basal cell carcinoma, and it may be absent in some of the most malignant melanomas. Melanosis oculi is a multiple and diffuse process involving the bulbar and the palpebral conjunctiva, which often extends onto the skin of the eyelids. Malignant melanoma may develop in any portion of the process.[1] Biopsy for diagnosis is always contraindicated when melanoma is suspected. Cutting into the tumor or its partial removal for diagnosis is dangerous. Radical treatment should be based on a clinical diagnosis alone.

Chalazion.—In the nonulcerated stage, the diagnosis of basal cell carcinoma may be confused with chalazion, since these two lesions present several similarities in appearance. On close examination, however, the deeper subcutaneous location of chalazion becomes evident, and usually the overlying skin is normal and movable over the underlying tumor.

Papilloma.—This growth usually presents a warty, nonulcerated, often pedunculated lesion, the clinical features of which suggest its benign character. Nevertheless, one should always be suspicious of an apparent papilloma or the so-called "cutaneous horn" which presents a thickened collar at the base, a finding which indicates malignant change.

Nonpigmented Nevus.—This growth may usually be distinguished by a long history, lack of induration and the more normal appearance of the epithelial surface.

Cyst of the Glands of Moll.—This lesion occurs near the palpebral margins and to superficial examination sometimes resembles nonulcerated basal cell carcinoma. Close examination, however, will reveal it to be

1. Reese, A. B.: Precancerous Melanosis and Diffuse Malignant Melanoma of the Conjunctiva, Arch. Ophth. **19**:354-365 (March) 1938.

transparent and cystic rather than translucent and solid, as in basal cell carcinoma.

Xanthelasma.—This condition may be distinguished by its yellow color, its long duration, the multiplicity of the lesions and their characteristic location in the inner aspects of the upper and lower eyelids.

Biopsy.—If a diagnosis of basal or squamous cell carcinoma is considered, confirmation should be obtained by biopsy if possible in all cases before treatment by irradiation. The smaller lesions may present some technical difficulties in this regard, but with the sympathetic cooperation of a competent pathologist a histologic diagnosis may be obtained from very small specimens of tissue.

INCIDENCE OF PATHOLOGIC TYPES

Cancer of the eyelids is found to be basal cell carcinoma in about 85 per cent of cases. Adenoid basal cell carcinoma, a more malignant and potentially metastasizing tumor, makes up an additional 5 per cent. Squamous carcinoma, which constitutes the remaining 10 per cent of the total, usually occurs in the upper eyelid and in the outer canthus. The comparative incidence of other malignant tumors of the eyelids, such as melanoma, is so small as to have little influence on statistics.

GENERAL CONSIDERATIONS IN THE TREATMENT OF CANCER OF THE EYELIDS

Treatment of cancer of the eyelids does not differ materially from that of other cancers of the skin of the face,[2] except that the need for precautions to avoid injury to the function of the eye or its adnexa is directly proportionate to the proximity of the lesion to the eye. Most writers on this subject favor irradiation as the method of choice in the treatment of cancer of the eyelid, although a few recommend surgical excision alone in all cases (Benedict and Asbury,[3] Eller[4] and Wheeler[5]). It is not always realized that the treatment, either by surgical excision or by irradiation, of cancer of the eyelids or of any tissue adjacent to the eye is attended by some danger of immediate complications or of permanent injury to the visual function. Such injuries may be unavoidable with advanced cancer in these regions, but with small or

2. Martin, H. E.: Radiation Therapy in Skin Cancer, Am. J. Cancer **19**:605-621 (Nov.) 1933.

3. Benedict, W. L., and Asbury, M. K.: Treatment of Malignant Lesions of the Eyelids, New York State J. Med. **29**:675-677 (June 1) 1929.

4. Eller, J. J.: Carcinoma of the Skin, New York State J. Med. **38**:689-698 (May 1) 1938.

5. Wheeler: Personal communication to the author.

moderately advanced growths the degree of such damage depends largely on the judicious selection and application of the most suitable treatment in the given case.

Cancer of the eyelids is seldom a fatal disease. The records of the Memorial Hospital of several hundred cases show a mortality from this disease of less than 6 per cent, the fatalities occurring mainly from metastases of squamous carcinoma and less frequently from any complication of the more common basal cell carcinoma. The problem in treatment of cancer of the eyelids is therefore not one of saving life but one of effecting a cure with the smallest possible degree of functional and cosmetic defect. If cure of the disease and the saving of life were the entire problem, with no regard for the function of the eye and the cosmetic appearance, it would make little difference what form of radical treatment were used. Wide surgical excision, wide cautery excision and heavy irradiation would be equally successful and would obtain a cure in practically all instances.

Therefore, an unbiased consideration of the relative merits of the several methods of treatment should be confined to the selection of that particular method which in a given case will offer the best means of avoiding functional and cosmetic defects of the eye. From the practical standpoint, any supposed superior advantages of a method in effecting a permanent cure or in saving life are irrelevant. Since the question is not what method will effect cure in the most cases but how cosmetic and functional defects may be minimized, the respective inherent merits of surgical excision and irradiation should be considered from these standpoints.

In general, irradiation, if properly used, should be more conservative, since its purpose is to eradicate the cancerous growth without destruction of the adjacent normal tissues which comprise the tumor bed. One must admit, however, that this quality of irradiation is relative rather than absolute. In order to conserve the normal tissues adjacent to a tumor adequately treated by irradiation, the dose of radiation must be carefully adjusted to the minimum requirements of the lethal tissue dose for the tumor in question. The irradiation must be limited as much as possible to the volume of the tumor and in other respects so applied that the integrity and function of nearby structures are not markedly impaired. When these ideal conditions cannot be approached, it must be admitted that irradiation is not always the most conservative method, for instance with bulky radioresistant squamous carcinoma of the eyelid which has deeply invaded the orbital cavity. For such a growth the application of the necessarily intense, sometimes caustic doses of radiation is commonly followed by long painful convalescent periods with eventual loss of function of the eye. Under these conditions, surgical exenteration of the orbit (partly by cautery) is by far

the most conservative and expeditious procedure, with a lesser morbidity and a more acceptable degree of cosmetic deformity.

Surgical removal of cancer of the eyelids will admittedly effect a cure in practically all instances if the excision is wide enough. However, except with the smaller lesions, treatment of which is not difficult by either method, and in selected cases of bulky operable radioresistant tumors, wide surgical excision is undoubtedly attended by more marked cosmetic defects than irradiation.

The merits of irradiation and surgical excision of cancer of the eyelids cannot be judged adequately by their application to small early lesions alone. Properly applied, these two methods will produce equally good results with many small lesions. On the other hand, with the larger lesions (5 mm. and over) and with those situated in the inner canthus or on the palpebral margins, the best cosmetic and functional result will usually be obtained by irradiation.

Safe surgical excision of cancer necessitates a partial removal of the normal structure in which the tumor lies. If the major portion of an eyelid must be excised, the new portion of the lid formed from adjacent skin can have no cilia and no voluntary muscular control. If the lacrimal canaliculi are excised, no plastic surgical procedure will restore them. Since many of these functions of an excised eyelid cannot be restored by plastic reconstruction, it seems logical to employ more conservative measures whenever possible. If the growth is so far advanced that there is no hope of conserving the function of the eye, surgical excision is by far the most expeditious and satisfactory method, and the orbit should be exenterated. Irradiation and surgical excision may often be combined successfully when either method used alone would fail (fig. 8).

SELECTION OF THE TREATMENT METHOD

It will be best to consider the selection of treatment according to the anatomic characteristics of the growths and their stage of advancement.

Small, Superficial, Movable Lesions (up to 5 mm.).—Provided that there is no involvement of the canthi or of the palpebral margins, these small growths offer no particular difficulties and may be treated by either surgical excision or irradiation without the production of marked cosmetic or functional defects. In the head and neck clinic at the Memorial Hospital, practically all such small growths of the eyelids are treated by irradiation as the method of choice. A selection often might be made on the basis of the expediency of one or the other method or according to the training of the surgeon. If, however, there is involvement of the palpebral margin or one of the canthi, irradiation

is definitely preferable to surgical excision. Exceptions to this rule are malignant melanoma and some squamous carcinomas, both of which are relatively radioresistant. Multiple tumors or those occurring in the presence of widespread precancerous keratoses of the skin of the face are problems for irradiation, surgical excision usually being contraindicated.

Moderate-Sized Lesions (6 to 15 mm.).—Surgical excision of the larger growths (figs. 2 and 3) would in most instances require a fairly extensive removal of tissue, necessitating the closure of the defect by skin grafting or the transposition of plastic flaps. For these reasons, I believe that for this group irradiation is usually preferable, and in support of this contention the end results shown in figures 2, 3 and 4 are submitted. A conserved eyelid, even though slightly scarred and atrophic and partly devoid of cilia, but retaining its conjunctiva and

Fig. 8.—*A*, extensive postoperative recurrent basal cell carcinoma of the lower eyelid which has deeply invaded the orbit and its floor. *B*, healed condition after treatment by a combination of heavy external and interstitial radiation followed by removal of the local area by means of cautery.

its voluntary muscular control, should be preferable to an eyelid constructed from adjacent skin, devoid of muscular control and accompanied by distortion of the surrounding parts.

Far Advanced Cancers of the Eyelids.—These lesions present no particular difficulty to cure by radical treatment, but the best end result may require considerable variation in technic and combinations of methods. A combination of irradiation and surgical excision often permits of cure with fairly good cosmetic and functional results. Such a combination of procedures is best illustrated by figure 5 *A*, in which a bulky, fungating basal cell carcinoma had invaded practically the entire lower eyelid and the inner canthus. The growth was controlled by fractionated roentgen irradiation with protective shielding of the eye, and healing finally took place, with the result shown in figure 5 *B*.

It will be noted that the growth had destroyed and eroded so much of the substance of the eyelid that in the healed state a definite defect persisted, the degree of which was certainly less than would have been present after wide surgical removal. The resultant defect was repaired by plastic surgical reconstruction of a new lower lid, with the end result shown in figure 5 *D*. The new lower lid, although devoid of muscular control, is sufficient to protect the cornea and permits of almost complete closure of the palpebral fissure. Such a combination of methods is often indicated and in selected cases will produce an end result not possible by either irradiation or surgical excision alone.

The optional use of surgical excision for small, sharply delimited lesions of the skin separate from the palpebral margin and the conjunctiva has already been mentioned. Surgical excision is often the most expeditious method of management for certain advanced lesions, as for example, that shown in figure 7. This growth, a squamous carcinoma, had invaded practically the entire free portion of the lower eyelid and in addition had extended deeply, so that an indurated, fixed mass was palpable in the floor of the orbit. The extent and probable radioresistance of this lesion made its control by irradiation improbable, except in such intensity and dosage as would certainly destroy the function of the eye, with marked local complications and an extended convalescence. It therefore seemed more logical and expeditious to exenterate the orbit, with the end result shown in figure 7 *B*. In all similar instances one should anticipate the eventual loss of the eye and proceed accordingly. The patient with such extensive and radioresistant cancer is fortunate indeed if his lesion is still curable by any means, no matter how drastic.

Malignant melanoma of the skin or conjunctiva of the eyelids is such a highly malignant and radioresistant tumor that wide surgical excision should be made in all cases as soon as the diagnosis is established with reasonable certainty.

Irradiation is the sole recourse for certain far advanced inoperable cancers of the eyelids which have extended deeply into the orbit to invade bone or into the nasal cavities and into the subcutaneous tissues of the cheeks and forehead. Such advanced lesions are usually recurrent or persistent after repeated unsuccessful surgical removal or repeated attempts with inadequate irradiation. The management of many of these lesions is palliative, especially if the patient has already received a large total of irradiation in inadequate, widely spaced, individual doses. Frequently the disease may be permanently eradicated by aggressive fractionated roentgen irradiation, although the dose required may be so high that the avascular granular surface or the denuded bone will never completely heal (fig. 9). Nevertheless, such a permanent unhealed condition, when otherwise unavoidable, is surely preferable to a steadily eroding cancer.

TECHNIC OF TREATMENT

Low Voltage, Lightly Filtered or Unfiltered Roentgen Irradiation (100 to 120 kilovolts).—This agent is undoubtedly the most useful and the safest form of irradiation in the treatment of cancer of the skin, and it is particularly indicated in lesions of the eyelids. While a discussion of the comparative advantages of low voltage roentgen irradiation for the treatment of cancer of the skin in general as compared to other forms of irradiation is beyond the scope of this paper, its particular indication for cancer of the eyelids is that its radiant energy is of such moderate penetrative power that it can readily be shielded off from neighboring structures, such as the lens and the cornea. The importance of protective shielding in radiation therapy near the orbital region has been discussed in detail by Watson and Wuester.[6] For this purpose, two shields are used. One is placed in the conjunctival sac to protect the cornea and the lens from the beam of radiation which is to pass

Fig. 9.—*A*, extensive basal cell carcinoma arising in the inner canthus, eroding both eyelids and invading the orbit and the skin of the nose. *B*, healed condition after treatment by a combination of low voltage roentgen irradiation and radon seeds. A small area of bone is exposed on the inner wall of the orbit.

through the tumor in the overlying lid. A second shield, with an aperture or window about 2 mm. beyond the visible and palpable borders of the growth, is applied so as to limit the external portal to the tumor itself (fig. 10). The shield for the conjunctival sac consists of an oval piece of lead (2 or 3 mm. thickness) shaped and contoured to conform to the anterior surface of the globe. The surface of this shield should be polished smooth and coated with petrolatum, but the application of a layer of paraffin, as has been formerly advised to absorb secondary irradiation, is unnecessary. Before the insertion of the device, the conjunctival sac should be anesthetized with a few drops of a 0.5 per cent solution of pontocaine hydrochloride.

6. Watson, W. L., and Wuester, W.: General Considerations in Radiation Treatment of Skin Cancer in the Region of the Eye, Am. J. Ophth. **21**:261-263 (March) 1938.

The second shield, which has been previously prepared with the proper-sized aperture or window, is then accurately placed and fastened with adhesive tape, and the x-ray tube holder with its cone or other limiting device is brought into proper position. The penetrative power of lightly filtered roentgen radiation at low voltage is so feeble that practically all radiant energy is absorbed by these lead shields, affording adequate protection to neighboring sensitive structures.

The dose as expressed in roentgens for these small portals varies widely, depending on the exact physical factors of the x-ray machine and the size of the portal. As now used for this purpose, in the head and neck clinic of the Memorial Hospital, the physical factors are 100 kilovolts, a target-skin distance of 30 cm. and no filter (except the wall of the tube). With these factors, a dose of 9,000 to 10,000 roentgens in one application through a portal 1 to 1.5 cm. in its longest diameter produces only moderately severe reactions. With portals 2 to 3 cm. in

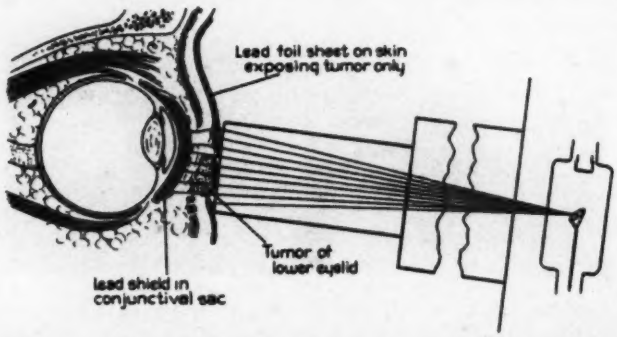

Fig. 10.—Method of treating a growth of the eyelid by low voltage roentgen irradiation with complete protection of the surrounding neighboring structures by the use of two lead shields, one in the conjunctival sac and one on the skin, with a window in the latter to expose the tumor narrowly.

diameter, the total dose with the foregoing factors is cut to 6,500 to 8,000 roentgens.[7] Low voltage roentgen radiation in such doses is not sufficient in all cases but often must be supplemented by the use of radon gold seeds. The details of this combination of technics and the doses are described in the following paragraphs.

Fractionated Roentgen Irradiation.—For the curative or palliative treatment of bulky extensive cancer of the eyelids, fractionated roentgen irradiation may be given by a variety of technics, depending on the features of the individual lesions. Lightly filtered low voltage roentgen

7. The effect of a variation in the physical factors of the roentgen irradiation is illustrated by the fact that this same x-ray machine formerly used at 140 kilovolts produced the same physiologic reactions in tumors of the skin and eyelid with doses of from 3,500 to 6,000 roentgens.

radiation (100 to 140 kilovolts) or high voltage roentgen radiation (200 kilovolts) may be used. The total doses must, in most instances, be high and approach the local and general tolerance. In certain instances the local tolerance should be exceeded purposely in an attempt to cure advanced cancer, even if complete healing never takes place. For such technics, no data on specific doses can be given, since these must vary widely, depending on the size of the portal, the thickness of the lesion and the quality of the irradiation.

Radon Seeds.—Gold filtered interstitial implants are sometimes indicated when the lesion has deeply invaded the orbit, with the total mass of the tumor still being only about 1 cm. in diameter. In most instances, however, the application of seeds is best preceded by roentgen irradiation. When radon seeds are used alone, the dose should be calculated to deliver at least 5 or 6 skin erythema doses and preferably 10 skin erythema doses to the tumor. The tables of doses for such interstitial irradiation and the proper geometric arrangement of the implants are fairly complicated and beyond the scope of this presentation. A detailed discussion of these subjects has already been published.[8] Owing to their greater bulk, radium element needles, even in the smaller sizes, are less satisfactory than radon seeds.

The decision as to the necessity for the use of radon gold seeds to supplement roentgen irradiation should be made about fifteen to twenty days after the roentgen irradiation. If at that time the intensity of the radiation reaction and the regression of the tumor are considered insufficient, supplementary seeds should be implanted. The individual strength of such seeds should not exceed 1.5 millicuries. The number depends on the size of the lesion. Ordinarily they should be placed at least 6 to 8 mm. apart. The proper dose and technic is somewhat empiric and must be learned by experience.

Contact Application of Unfiltered Radon.—Small superficial growths arising directly on a palpebral margin are often most satisfactorily treated by the direct contact application of unfiltered radon. At the Memorial Hospital such an applicator is known as the "radon bulb" and consists of a small glass bulb about 5 mm. in diameter containing 100 to 500 millicuries of radon. The glass bulb is held in a small cup-shaped metal container attached to a wire handle (fig. 11). The glass bulb is held directly in contact with the lesion, and since there is no filter except the intervening glass, the effect is concentrated and superficial from the preponderance of the relatively nonpenetrating beta rays. The dose is calculated as the product of the strength in millicuries and the time in minutes, and for the average small superficial lesion it varies

8. Martin, H. E., and Sharp, G. S.: The Use of Gold Filtered Radon Implants in the Treatment of Intraoral Cancer, Am. J. Roentgenol. **26**:28-38 (July) 1931.

from 250 to 500 millicurie minutes. During the short exposure, of from one to two minutes, the anesthetized eyelid may be grasped and held everted by a lid forceps, while a lead shield is interposed between the radon and the lens. With this applicator the penetrating gamma ray component is relatively so small as to be unobjectionable.

Radon Plaques and Element Needles.—Filtered external radon applicators in my opinion are not suitable for the treatment of cancer of the eyelids or, as a matter of fact, of any cancer of the skin of the upper part of the face. The reason for this unsuitability is that gamma rays are so penetrating that they cannot be shielded off from the lens and other structures of the eye by any thickness of filter which can be employed about the face. For example, a shield of lead 1 cm. in thickness removes only 50 per cent of gamma rays, and it will be conceded that, even though insufficient, this thickness of shield cannot be interposed practicably between the radon and the lens in the treatment of cancer of the eyelid. When radon plaques are used, the lesions themselves may regress satisfactorily, but the incidence of postirradiation

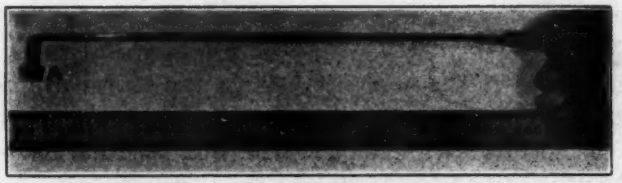

Fig. 11.—The radon bulb. The cup-shaped container at the end of the applicator (*A*) holds a glass bulb about 5 mm. in diameter containing from 100 to 500 millicuries of radon. There is no filter, and the glass bulb is placed in direct contact with the lesion so that intense soft beta irradiation is obtained.

cataract and of other less serious forms of radiation sclerosis of the lids and sclera is high. The same objection holds true to a lesser extent for radon seeds, but with the small single and total doses which are required for supplementary purposes in the treatment of cancer of the eyelids, the danger of subsequent radiation cataract is not great.

RADIATION REACTIONS AND REMOTE COMPLICATIONS

An epidermicidal reaction is necessary in the average case in which cancer of the eyelids is successfully treated by irradiation. This means that one to two weeks following the application of the radiation an erythema of the skin appears, which progresses until it causes a blistering reaction and a denudation of the epidermis, accompanied by regression of the tumor. The height of the reaction ordinarily occurs about twenty to twenty-five days after the treatment. Healing begins after about the twenty-fifth day and is usually complete in ten to fourteen days.

If the skin portal has been correctly sized and centered, this reaction should be rather sharply limited to the area of the tumor. Proper shielding within the conjunctival sac protects the cornea and the bulbar conjunctiva. In the case of some of the more bulky and deeply infiltrating tumors, adequate protection of the eyeball is physically impossible, and as a result the reactions may extend onto the limbus and the cornea. The cornea itself is rather resistant to average doses of radiation and ordinarily recovers completely. If the palpebral margin must be included in the portal of irradiation, the cilia drop out and usually do not regenerate.

When the erythema becomes fairly marked, a bland ointment should be applied to keep the surface soft and to prevent cracking. As the reaction deepens and the superficial layers of the epidermis are lost, the area should be kept covered by small patches of fine mesh gauze bandage impregnated with petrolatum or boric acid ointment. It is seldom that the irritation of the conjunctiva calls for any special measures.

Radiation Cataract.—One of the late complications of radiation therapy of the eyelids is radiation cataract, which may come on at any time between twelve and thirty-six months. For the smaller lesions, this complication can be prevented almost entirely by the use of low voltage roentgen radiation with proper shielding. As has been previously mentioned, gamma radiation cannot be shielded by any practical thickness of metal shield. Many writers on this subject [9] have mentioned the frequent incidence of radiation cataract unless adequate precautions are taken to protect the eye from even moderate doses of radiation. Hailey [10] has rather minimized the incidence of this complication and the necessity for protection of the eye. In the head and neck clinic at the Memorial Hospital it has recently been found that the incidence of radiation cataract following radiation therapy of cancer of the head and neck is much greater than was formerly realized. This complication has been seen to occur following successful irradiation of cancer of the paranasal sinuses or nasal pharynx as well as of the skin of the upper part of the face. The true incidence of radiation cataract cannot be discovered except by ophthalmoscopic examination of all patients who have received radiation therapy to the upper part of the head. In most instances the patients themselves are unaware of the condition and accept the failing vision as a natural consequence of poor health and advancing age.

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9. Pohle, E. A.: Radiation Therapy in Carcinoma of the Skin with Special Reference to Advanced Lesions, Colorado Med. **34**:895-899 (Dec.) 1937. Ebbehöj, E.: Radiotherapy of Cancer of the Eyelid, Hospitalstid. **79**:717-726 (July) 1936. Hollander, L., and Baer, H. L.: Common Disorders of the Skin of the Eyelids, Am. J. Ophth. **18**:616-623 (July) 1935. MacKee, G. M.: X-Rays and Radium in the Treatment of Diseases of the Skin, ed. 3, Philadelphia, Lea & Febiger, 1938.

10. Hailey, H.: Radium Treatment of Epithelium of the Eyelid, South. M. J. **27**:681-683 (Aug.) 1934.

SURGICAL TECHNIC IN THE TREATMENT OF CANCER OF THE EYELIDS

A variety of procedures for ophthalmic plastic operations, including the repair of defects of the eyelid, has been collected and described by Spaeth.[11] If small malignant or benign lesions of the eyelids are excised surgically, an elliptic incision should be used with its long diameter vertical, if possible, in the lower eyelid, so as to avoid the danger of ectropion. In the upper eyelid the ellipse should be horizontal. Reparative surgical measures are often indicated for the correction of defects which remain after control by irradiation of lesions which have partly eroded the eyelids, as shown in figure 5. Such procedures should be withheld for one to two years after irradiation, or until the greatest danger of recurrence has passed. After such an interval, the retraction in the scar and the progressive sclerotic changes have become more or less stationary. The surgeon experienced in the handling of irradiated tisues will not find these effects of radiation a great handicap, but as compared to plastic surgical repair of nonirradiated tissues, more attention should be directed toward minimizing operative trauma and toward providing an adequate blood supply for skin flaps.

A fungating or markedly protruding mass of tumor tissue on the eyelid may present mechanical difficulties in efficiently irradiating the zone of greatest importance, that is, the line of junction between normal and neoplastic tissue. In such instances it is often advantageous to remove the projecting portion down to the level of the skin by endothermy so as to permit of accurate and efficient subsequent irradiation of the base. Not only large bulky lesions but also the cutaneous horn with basal cell carcinoma at its base may be treated in this manner.

Surgical excision of advanced cancer of the eyelids invading the orbit may sometimes be performed by means of the scalpel and blunt dissection with immediate skin grafting of the orbital cavity. A large split graft taken from the thigh is placed raw surface outward over a gauze tampon and introduced into the orbit, where it is held by firm pressure. More extensive and deeply invading cancers of the eyelid are best excised by the actual cautery, the wound being packed and left to heal by granulation.

TREATMENT OF BENIGN NEOPLASMS OF THE EYELID

Papilloma.—When a papilloma is pedunculated or attached by a fairly narrow base, it is safely removed by endothermy or even by a fine wire cautery with light cauterization of the base. Even the sessile variety is often satisfactorily dealt with by this means. A modification.

11. Spaeth, E. B.: Operations on the Eyelid, in Berens, C.: The Eye and Its Diseases, Philadelphia, W. B. Saunders Company, 1936, pp. 1043-1069.

useful in some instances, is the application of unfiltered radon (radon bulb) to the base after endothermy removal. The cauterized base is left to heal by secondary intention. Should the base be more than 4 or 5 mm. in diameter, it is sometimes preferable to excise the lesion narrowly and suture the defect. The greatest danger in dealing with papilloma is error in diagnosis. One should always be on the lookout for a thickened collar or for slight infiltration at the base, which is indicative of basal cell carcinoma. The proper treatment for papilloma is frequently inadequate for basal cell carcinoma.

Nonpigmented Nevus.—The treatment for such a lesion is surgical, either by the scalpel or by endothermy as for papilloma, except that irradiation should never be employed, either alone or in conjunction with surgical excision. The significance of a nonpigmented nevus is usually only cosmetic. In the average case the lesion has been present for many years, and if the patient himself has no concern, it is doubtful whether the surgeon should advise any intervention. Owing to the present day propaganda for the control of cancer, many persons acquire cancerophobia, and the removal of a nevus is sometimes justified for this reason alone. It is doubtful whether a nonpigmented nevus of long standing ever degenerates into a cancer, and its prophylactic removal suggests a lack of confidence by the surgeon in his own diagnostic ability.

Hemangioma.—This type of lesion, if deep red, compressible and raised above the surface of the skin, is responsive to any one of several methods of treatment, all of which depend for their success on a destruction or sclerosis of the excess of vascular elements which make up the growth. Irradiation, the interstitial injection of sclerosing solutions and the application of solid carbon dioxide all produce similar effects in this regard. The best procedure is to induce a slow gradual sclerosis by the repeated application of more than one of these methods. One should depend mainly on the application of solid carbon dioxide and the injection of a solution of sodium morrhuate in rotation at intervals of two to three weeks, irradiation being avoided if possible for such lesions near the eye.

Premalignant Melanosis.—Benign or premalignant melanosis, especially that of the skin of the eyelids, is often fairly sensitive to irradiation and may frequently be controlled by that means in those instances in which the surgeon would hesitate to recommend and the patient would be unwilling to accept a drastic surgical removal. As Reese[1] has pointed out, the most important consideration in these cases is diagnosis. For marked and widespread melanosis of the eyelids and conjunctiva, the prudent surgeon will advise exenteration.

PROGNOSIS AND END RESULTS

A report of the five year end results in cases of cancer of the eyelids, the same standard being used as for other more malignant anatomic forms of cancer, would not be particularly revealing. The end results for cancer of the eyelids had therefore best be appraised on the basis of the degree of conservation of normal appearance and function after treatment.

Cancer of the eyelids is not a highly fatal disease. Even though it recurs, the condition can almost always be cured eventually. In 85 per cent of the series of about 150 cases at the Memorial Hospital, the first treatment was successful. About 7 per cent of the patients required more than one treatment, either for recurrent cancer in the healed area or for the development of a new lesion in another site in the eyelids. Only about 6 per cent of the patients died of the disease, and practically all of these had squamous carcinoma and succumbed either to local deep invasion or to distant metastases after a period of more than five years. Incompletely controlled basal cell carcinoma of the eyelids or elsewhere about the skin of the face is always a slowly progressive disease. Patients may live thirty to thirty-five years with persistence of this form of the disease and then die of other causes.

SUMMARY

Cancer of the eyelids is an important subtype of cancer of the skin of the face. The disease is not highly fatal, and its significance lies chiefly in the fact that the growth itself or its treatment may result in serious impairment of the vision. A less important consideration is the cosmetic defect. Many smaller lesions may be treated either by irradiation or by surgical excision with acceptable end results. Moderate-sized growths are most satisfactorily treated by irradiation. Extensive tumors often require radical surgical excision or a combination of irradiation and surgical excision.

TRANSPLANTATION OF THE CORNEA

REPORT OF A PERFECT RESULT

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It is now an established fact that when an eye is blind solely because of opacities of the cornea sight can be restored to the patient by removing a disk of the opaque cornea and replacing it with a disk of transparent cornea obtained from a human eye. The graft seldom fails to unite, and there is no danger of ophthalmitis or loss of the eye, provided the conjunctival sac has been rendered bacteriologically clean by preliminary treatment. One is therefore justified in operating on a person who formerly would have been considered unsuitable in the hope of restoring some slight vision, as the worst that can happen is that the graft will become opaque, in which case the patient is no worse off than he was before operation. In the majority of cases the surgeon is satisfied if he can restore a small amount of vision, so that the patient will be able to find his way about unaided. Even in cases in which conditions are unfavorable for operation one is often agreeably surprised with the results obtained. If anterior synechiae are present, the anterior chamber should be reconditioned before a grafting operation is carried out. Every effort should be made to prevent the iris from becoming adherent to any part of the graft, as there will be a formation of fibrous tissue and the graft will become opaque. If after removal of the corneal stitches anterior synechiae are present, it is wise not to delay the separation of these adhesions, and this can often be accomplished without much difficulty. In my experience it is the exception not to be able to improve the vision of the eye, however slight the improvement may be, but the best results are obtained in cases in which the corneal opacities are due to interstitial keratitis, the result of congenital syphilis.

In 1930 Elschnig [1] reported the results of 174 operations, 34 clear grafts being obtained. As far back as 1920, one of his patients had normal vision after keratoplasty and correction with a lens. To my knowledge, this is the only case so far recorded in which normal vision was recovered.

1. Elschnig, A.: Keratoplasty, Arch. Ophth. **4**:165 (Aug.) 1930.

Filatov [2] in the period from 1923-1932 performed 96 partial penetrating corneal transplantations and obtained 13 clear grafts. His maximum result was vision of 7/10 in 1 case.

Thomas [3] in the period from 1930-1936 performed 36 partial penetrating corneal transplantations and obtained 12 clear grafts. His best result was 6/12 and 6/9 (partly).

Since 1934 keratoplasty is a comparatively common operation at the Eye Infirmary in Calcutta. There is considerable demand in India for relief from blindness by corneal grafting, and suitable grafting material is easy to obtain. Blindness due to corneal opacities is common and is produced by interstitial keratitis, chemical burns, fireworks during the Hindu festival of the Diwali and large ulcers. The material for grafting

Fig. 1.—Appearance of the eye before operation.

is most often obtained from eyes which become blind after the couching operation for cataract, from blind painful glaucomatous eyes and from eyes exenterated for malignant disease. It has been my experience that the eyes of donors blind from glaucoma furnish good grafts, and it is unnecessary to choose a donor of the correct blood group.

The following case in which corneal transplantation was done is of interest as the result is perfect; i. e., normal vision was obtained, which at the time of writing had persisted for six months after operation. Previously the best result I had obtained was 6/18 and 6/12 (partly), with correction, seventeen months after operation.

2. Filatov, V. P.: Transplantation of the Cornea, Arch. Ophth. **13**:321 (March) 1935.

3. Thomas, J. W. T.: Results of Corneal Transplantation, Brit. M. J. **1**:114 (Jan. 16) 1937.

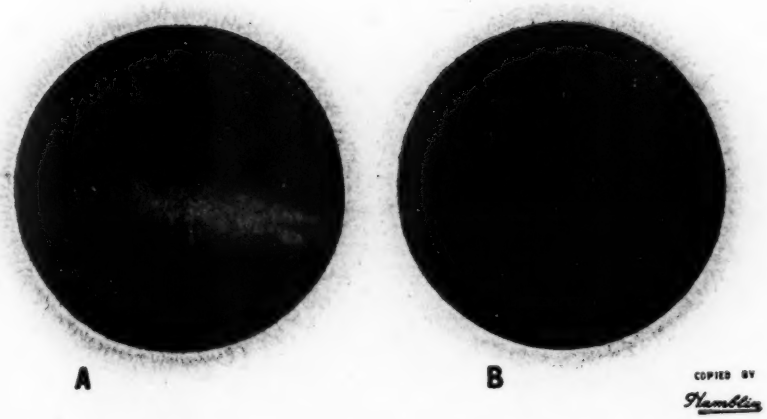

Fig. 2.—*A*, appearance of the eye before operation, as seen with the corneal microscope. *B*, appearance of the eye after operation. Magnification, × 3.7.

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REPORT OF A CASE

K. D., a Hindu woman aged 26, came to the Eye Infirmary of the Medical College, Calcutta, on April 1, 1937, suffering from defective vision in the left eye. She gave a history of an inflammatory attack in the left eye about twelve months previously. She gradually lost the vision in this eye. The right eye was not affected. Her condition was diagnosed as interstitial keratitis. The Wassermann reaction of the blood was positive. She was given a prolonged course of injections of arsphenamine and a bismuth preparation, and the pupil was kept dilated with atropine. She was admitted to the hospital on August 7. The blood was again tested for the Wassermann reaction, which was found to be negative. The right eye was normal. A dense corneal opacity involved the whole extent of the cornea of the left eye but was less opaque in the upper third. Through the upper part of the cornea the anterior chamber could be seen. The depth was normal, and the pupil was active and normal in shape. Vision was 1/60. Examination with the corneal microscope showed that the right cornea was normal. The left cornea showed a dense opacity involving the substantia propria, with considerable deep vascularization. On September 1 keratoplasty was done on the left eye. The donor was a Hindu woman aged 60. The eye was blind from iridocyclitis with secondary glaucoma, the result of a couching operation for cataract. The donor's cornea was clear, and there was no keratitis punctata. The eye was quiescent, but the tension was slightly above normal. The diameter of the graft was 4.5 mm., and that of the trephine hole in the recipient's cornea was 4.75 mm. The graft was kept in position by two fine silk cross sutures, one arranged in the form of a cross and the other in the form of an x. These sutures were passed through the opaque cornea adjacent to the site of the graft but did not perforate the cornea. The course after operation was uneventful. The sutures were removed on the fifth day. Vision gradually improved; the graft remained perfectly clear throughout, and at the time of the patient's discharge from the hospital two months after operation vision was 6/18. Four months after operation the graft was still perfectly clear; the anterior chamber and the pupil were normal, and vision was 6/6. The periphery of the cornea surrounding the graft had cleared considerably. This phenomenon is noticeable in many cases of corneal transplantations. When the patient was seen on March 22, 1938, nearly seven months after operation, vision was 6/6. The cornea presented an excellent picture. The graft was as clear as crystal, and the periphery of the cornea had cleared tremendously but still showed a gray haze.

With the corneal microscope the junction of the graft showed a narrow white circle, and the epithelium was continuous but was thicker at the junction; on either side of this junction throughout the whole of the substantia propria fibrous tissue cells extended for a short distance. Bowman's and Descemet's membranes were interrupted, but the endothelium was continuous. There were no blood vessels to be seen in the graft. The patient was again admitted to the hospital on June 13, suffering from acute conjunctivitis of the eye which had been subjected to operation. This cleared on simple treatment, and the cornea was not affected. The patient was discharged from the hospital on June 28. The graft was perfectly clear, and the vision ten months after operation was still 6/6.

COMMENT

My reason for carrying out corneal transplantation on a patient with normal vision in one eye was that the other eye was almost blind from

corneal opacities, the result of interstitial keratitis due to congenital syphilis. In Calcutta syphilis is common, and interstitial keratitis occurs frequently in patients of a much older age than in Great Britain. One eye is often affected first, infection of the other eye usually following at a later date. The chances of obtaining useful vision in older persons with interstitial keratitis are not good. In the case reported here it is probable that the sound eye will be affected by interstitial keratitis later. This has happened in 2 of my cases in which corneal transplantation was done.

OCULISTS AND OCCULTISTS

DEMONOLOGY AND THE EYE

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Man has always striven to preserve his youthful vigor and to prolong his existence. The means he employed were not always the same, for they depended in a large measure on his state of culture. In his primitive state, when he believed that physical abnormalities were brought about by supernatural forces, he employed magic. Later, when his observation of the heavenly bodies stirred his imagination, he supplemented his healing art with the pseudoscience of astrology. Both of these methods to alleviate disease were often associated with religion, which claimed for itself the ability to cure disease by divine power. Modern medicine, which has undergone an extensive evolution, has taken its origin from magic and other occult sciences, chief of which is the doctrine of demonology.[1]

From the very dawn of history the belief in demons was universal. "There are people without a God," said Huxley, "but there are no people without spirits." The idea that demons were the cause of diseases was deeply rooted among races and peoples the world over. Especially have such beliefs prevailed with reference to the eye. Its complicated and misunderstood mechanism lent itself to all kinds of speculative superstition. The early man saw in the pupillary image of his sick friend the evil spirit that took possession of him. His conviction was strengthened with the disappearance of the spirit in cases of opacities of the cornea and diseases of the media which left the eye blind.

In classical Greek literature demonology and religion overlap considerably. The early Greeks made no distinction between gods and demons. Among the most interesting passages in Greek mythology are those in which Hesiod tells how the men of the Golden Race on death became demons and guardians and watchers of mortals. Empedocles (490-430 B. C.) and Plato (427-347 B. C.) regarded

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This article is the second of a series on occult sciences and their relation to the eye. The first, entitled "Oculus Fascinus" (Fascination, Evil Eye), appeared in the February 1937 issue of the ARCHIVES, pp. 290-319.

1. The original significance of the word demon is doubtful. In classical Greek literature it denotes "science of religion."

them as intermediate beings between the gods and men. There were good and bad demons, depending on the work they were sent to perform. Aristotle (384-322 B. C.), the son of a physician, spoke of demons influencing and inspiring the possessed.

The Babylonians viewed all demons as malevolent. According to Aeschylus, the Chaldeans (Babylonians) believed demons to be the cause of all diseases and mishaps of life. All grievances, and emotions, such as love, hate, jealousy or anger, were regarded by the Chaldeans as the work of demons. According to Aeschylus:

> They are mischievous. They make a son leave the father's house; the slave sit in the master's place; they cause the ox and the lamb to go astray; they order the young bird to fly out of the nest; and they assail country after country with pestilence and sickness.

In the cuneiform inscriptions demons are pictured as spiteful beings. The arch demon was known as Tiamat. He ruled over seven evil deities known as *sheidim*. The most rabid one is frequently portrayed in the cuneiform literature in the form of an ox.[2]

The pathogenic demon governing the visual organ was considered by the Babylonians particularly malevolent, for he attacked the largest part of the population. Of the 660 medical texts[3] discovered in the royal library of Assur-Bani-Pal (dating from 668-626 B. C.), an unusually large number deal with diseases of the eye. Charms and incantations were prescribed to render the demon powerless.

The ancient Egyptians firmly believed that supernatural beings controlled all affairs of life. Everything in nature, even the elements themselves, were thought to be governed by spirits. Spirits exerted a great influence on men, causing vexation and disease by stealthily entering their bodies.

On a stele set up in the temple of the god Khonsu at Thebes (about 1250 B. C.) during the reign of Ramses II it is recorded how that monarch sent a court physician to Bekhten in Mesopotamia to cure the princess Bentarisht, the sister of his royal spouse, Re-nefer (*Re* is beautiful). On reaching Bekhten, the priest-physician diagnosed the disease of the princess as paralysis of the limbs due to the entrance of a demon over which he felt powerless to effect any cure. When he reported this condition to Ramses, the latter sent the god Khonsu-

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2. It is probably the same as the Talmudic *sheiyah*, the demon found in desolate houses (Talmud: Baba Kama 21a).

3. These tablets are now preserved in the British museum. Copies of the texts may be found in Thompson, R. C.: Assyrian Medical Texts, from the originals in the British Museum, New York, H. Milford, 1923. For translations, refer to: Thompson, R. C.: Assyrian Medical Texts, Proc. Roy. Soc. Med. (Sect. Hist. Med.) **17**:1, 1924.

neferhetep to Mesopotamia. He was accompanied by magicians and sorcerers. As soon as the demon saw the god, he cried out: "Great God who chasest demons, I am thy slave. I will go to the place whence I came." Thereupon sacrifices were offered to the spirit, and he went in peace, leaving the princess cured.

The arch demons of Egypt were known as Set-tebha and Apepi. Hathor, the subdemon who controlled the function of vision, was evilly disposed toward the Egyptians. The oldest medical document, known as Papyrus Ebers (1500 B. C.), lists a large number of diseases of the eye which were prevalent among the Egyptians, one of which was the Egyptian "ophthalmia" (trachoma), which is still endemic in the land of the Pharaohs. It was brought to Europe at the end of the eighteenth century by the soldiers of Napoleon after the close of his campaign in Egypt.

The Persians accepted this fantastic belief from the Babylonians and Egyptians and made numerous additions to it. They ascribed disease to evil genii and cures to the influence of good spirits. Ahoriman (Talmudic Hurmin), the arch evil *daeva,* had myriads of subordinates, as did Armuzd, the chief of the benevolent demons. The last endeavored to conquer the disease and death that were produced by the first. The king of all spiritual beings was known as Aeshma (Talmudic Asmedeus [4]). According to Persian demonology, there were male and female *daevas.* They were believed capable of reproducing their own species [5] and, since they were considered to be of divine and human alloy, they were qualified to mediate between men and the gods. They were supposed to inhabit unsanitary places and feed on decomposed animal and vegetable material. Pronouncing the holy word was considered the best method of treatment. "If several healers present themselves, one who heals with the knife, one who heals with herbs and one who heals with holy word, it is the last one who will best drive away sickness from the body."

Despite the clear logic of the Greeks, the belief in, and worship of, spirits occupied a prominent part in their lives. At an early period they attributed diseases to malignant spirits. Homer (1000 B.C.), in his "Odyssey," wrote thus of a sick man: "One on whom the hateful demon had gazed and who was pining away." Empedocles attributed to demons all diseases and calamities that befell man, and Pythagoras [6] held demons responsible for diseases in men and cattle.

In the first book of the Memorabilia, Xenophon, in his efforts to exonerate Socrates from the charge of being a heretic, stated that in

4. (*a*) Talmud: Pesachim 110a. (*b*) Tobit 6:13.

5. Talmud: Hagigah 16a; Abboth d'Rabbi Nathan 37:7.

6. Cited in Demonology, in Cyclopedia of Biblical, Theological and Ecclesiastical Literature, New York, Harper & Brothers, 1894.

addition to making use of all forms of divination, Socrates had a familiar genius, a demon who communicated with him—"soul to soul."

In the philosophy of Plato [6] demons are considered inferior to the gods but superior to men. Plato was of the opinion that when a demon took possession of a person the latter was entirely overpowered and no longer able to think and speak, these faculties emanating not from the person but from the demon.[7] Apollonius, addressing a youth who was possessed by a spirit, remarked: "I am treated contumeliously by the demon, not by thee." [8] Lucian was convinced that the spirit in the possessed person answered all the queries made of the person. Zaleucus, in the preface to his book on laws, expressed the opinion that an evil demon might force a witness to testify falsely. Plutarch [9] was of the opinion that the moral conduct of man depended on spirits. He stated:

> It is a very ancient notion that there are certain wicked and malevolent spirits who envy good men and endeavor to hinder them in their pursuit of virtue lest they would partake of greater happiness than they [i. e., the evil spirits].

Virgil thus portrayed Sybil of Cumes, of whom the spirit of Apollo had just taken possession:

> However, still resisting Phoebus, the ferocious prophetess struggles furiously in her lair, trying to push from her breast the powerful god; but the more vigorously does the god press her foaming mouth and subdue her untamed will; he presses her and has his way with her.[10]

The mania of Quintus Fulvius was regarded as a punishment by the possessing spirit for having stolen the precious roof from the temple of Juno Lacinia at Locrinum.[11]

The Old Testament prohibits the worship of pagan divinities. "Thou shalt have no other gods before me" [12] is repeatedly stated. "It is the Lord Himself that sends pestilence and death." [13] "Deber and Reshaf are [only] the angels of God." [14] The sorcerer became a repellent sub-

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7. This was also the belief of the ancient Babylonians, as is shown from the following quotation from Jastrow: "If a man's forehead [is affected] and a demon in the man's body cries out. . . ." Jastrow, M.: An Assyrian Medical Tablet in the Possession of the College of Physicians, Tr. Coll. Physicians, Philadelphia **35**:395, 1913.

8. Compare Matthew 8: 28-29 and Luke 8: 27-32.

9. Plutarch, in Cyclopedia of Biblical, Theological and Ecclesiastical Literature, New York, Harper & Brothers, 1894.

10. Cited by Cailliet, E.: Why We Oppose the Occult, translated by G. F. Cole, Philadelphia, University of Pennsylvania Press, 1931, p. 34.

11. Locrinum was located a few miles off Crotton, forming the western boundary of the gulf of Terentina. The ruins of the temple are still in existence and are known as Capo di Nao.

12. Exodus 20: 3.

13. Exodus 15: 26.

14. Habakkuk 3: 5.

ject. He was regarded as an ally and servant of the spirits of evil in league against God. The Old Testament is against occult practices,[15] and the Book of Baruch[16] denounces demons as the idols of paganism.

But despite the Hebrew opposition to polytheism and spirit worship, their existence is recognized in the Bible.[17] Spirits were, however, powerless to act of their own accord. They were always subject to the will of God.[17a] Evil spirits are referred to in the Old Testament as *sheidim*.[18] They are also known as *seirim*[19] (goatlike), satyrs identified with the Arabian *jinn* of the desert. Other spirits mentioned in the Old Testament are *ketev meiri*[20] and Lilith,[21] the queen of the demons who reigns at night. In Rabbinic literature she is pictured with wings, long flowing hair and long nails and is the mother of Ahoriman (Talmudic Hurmin[22]).

Nahash[23] (serpent) is another Biblical designation for a wicked spirit. In the story of the fall of man the author of Genesis seems to have recorded a tradition preserved among ancient races. The serpent

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15. Leviticus 19:31; 20:6-27. Deuteronomy 10:12; 18:9.

16. Baruch 4:7

17. (*a*) Exodus 9:3; 12:29. (*b*) Footnote 12. (*c*) Deuteronomy 30:17. (*d*) Footnote 14.

18. Deuteronomy 32:17. Psalms 106:37. In the Greek version of the Old Testament *sheidim* signifies the gods of the Gentiles. Afterward they became known as demons. The Talmud gives the origin of *sheidim* from the Hebrew *sode* (the kings of the fields) (Gittin 68a). It might also have been derived from the term *shod*, meaning destruction.

19. II Chronicles 11:15. Isaiah 13:21; 28:2; 34:14. To the same class of demons belongs Azazel, the giant-like demon of the wilderness (Leviticus 16:10). Ibn Ezra pointed out that Azazel was originally a desert demon in the ravines near Jerusalem to whom a scapegoat was offered at the opening of the year, a rite preserved on the Day of Atonement (Leviticus 16:8).

20. Deuteronomy 32:24. Isaiah 28:2; 13:21.

21. Isaiah (34:14) derived her name from the Hebrew word *laila* (night) because she was supposed to rule during the night.

22. Talmud: (*a*) Baba Bathra 73b; (*b*) Erubin 100b; (*c*) Nida 24b.

23. Genesis 3:1-13. Few living creatures played such a fascinating part in medical history as the serpent. Among the innumerable legends is the one in which the serpent presents to Aesculapius an herb possessing miraculous powers of healing and enabling him to cure the sick and restore life to the dead. This aroused the anxiety of Pluto, who was an enemy of life, and he requested Zeus to slay Aesculapius in his prime with a bolt of lightning. Aesculapius is considered the patron saint of medicine. His heavy knotted staff around which a snake is entwined has been adopted as the medical emblem. The knotted appearance of the staff suggests knotted medical problems. The staff of Caduceus is not as popular an emblem. It consists of a slender stick made of an olive branch, which Apollo, the Greek god of light, life and poetry, gave to Mercury when he was appointed ambassador to the gods. It was adopted as a medical emblem in 1515 by William Botts. The dictum of Hippocrates, "Art is long, experience is difficult," is often added to the symbol.

was always considered a mysterious incitor of evil. He is found in the mythology of Egypt, Mesopotamia, India and Persia. "Everywhere," stated Westphal, "the serpent personifies the power of darkness." He is said to be the most ancient figure by means of which mysterious powers of evil were designated. In Talmudic literature he is often known as Nahash hakadmoni [24] and is identified with the Persian Ahoriman (Talmudic Hurmin).

The most dreadful and terrible spirit was Satan. He is described as the mortal enemy of Israel (angel of death and evil thought). In the Book of Zachariah [25] Satan is considered the foe of the Hebrews. In the prologue to the Book of Job [26] Satan plays the role of an enticer of evil and inflictor of disease. He acts as a messenger, thoroughly submissive to the will of God. In the First Book of the Chronicles [27] Satan provokes David to transgress against the will of God and thus becomes the enemy of Israel.

DEMONIC BELIEF IN THE OLD TESTAMENT AND APOCRYPHA

The Old Testament contains only one instance that could possibly be interpreted as one of demonic possession—the case of Saul.[28] However, even here the construction of the passage, "The evil spirit of the Lord troubled him," does not necessarily apply to demonic possession in the accepted meaning. Josephus reflects the popular belief of possession in the statement: "But as for Saul, some strange and demonic disorder came upon him; such suffocation as was ready to choke him.[29]

The two spirits protecting Lot from the mob "smote the men that were at the door of the house with blindness." [30] The blindness of Tobit, caused by a leukomatous condition of the cornea, as recorded in the Apocrypha, does not seem to have been demonic in origin. The cure, however, was effected by the intervention of the benevolent spirit Raphael.[31]

It was probably because of the belief of demonic possession that ancients regarded blindness as the lowest form of degradation. The blind were considered outcasts of society and were kept quarantined outside the city gates. Hence, when David besieged the Jebusites of Jerusalem he took stringent measures against them.[32]

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24. Talmud: Sanhedrin 29b; Baba Bathra 16.
25. Zachariah 3:1.
26. Job 1:7; 2:2.
27. I Chronicles 21:1.
28. I Samuel 16:14.
29. Josephus, F.: The Jewish Antiquities, translated into English by W. Whiston, Boston, S. Walker, 1833, book 6, chap. 8.
30. Genesis 19:11.
31. Tobit 3:17.
32. II Samuel 5:6.

According to Josephus, demons were spirits of the wicked who entered men and killed them unless some help against them could be obtained by exorcism or by fumigation. Josephus credited King Solomon with the authorship of a book on occult science, "The Clavicules of Solomon," and also with the supernatural power to cast out demons by incantation, "a science useful to man." [33]

POSTBIBLICAL CONCEPTION OF SPIRITS

After the Babylonian exile (586 B.C.) the occult sciences became widely spread among the Hebrews, as is apparent from the Apocryphal and the Talmudic literature. Demons became known by specific names, and diseases were frequently attributed to them. Philo, who endeavored to blend the Old Testament with Hellenic doctrines, asserted that there were good as well as evil demons. Angels, demons and souls were identical to him. "Moses called those 'angels' whom the Greek philosophers chose to call 'demons.'" [6]

Of the three sects that dominated Jewish life at the beginning of the Christian era, the Essenes [34] exerted the most powerful influence on the followers of Christianity. They claim the power of invoking the good spirits and conjuring the evil ones and the ability of curing diseases due to possession. The New Testament admonishes the Sadducees for their denial of the existence of angels and spirits.[35] The Pharisees [36] followed a middle course; they confessed the existence of supernatural beings but considered them unclean and endeavored to repel them not by magic formulas or exorcism but by the study of the Torah and by the spirit of holiness. The belief in occultism never became an essential feature of Jewish theology,[37] although the reality of demons was never questioned by Talmudic rabbis.

Talmudic demonology is a mixture of Babylonian and Persian beliefs. Satan, or Hurmin, is said to have six submissive demons, known

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33. Josephus, [29] book 2, chap. 5; book 8, chaps. 2-5.

34. Essenes ("the healers"), a mystic Jewish sect preceding the Christian era, conformed most rigidly to Levitican purity. They lived solely by the work of their hands. They abstained from conjugal intercourse and sensual pleasures. They lived in isolated places, devoting themselves to study and devotion, and they prayed for the Messianic era to come (Talmud: Abodah Zarah 9:15. Luke 2:15).

35. Acts 23:8. The Sadducees hailed from the priestly family. They were of radical tendencies and were great admirers of Greek culture.

36. The Pharisees represented the ultrareligious views of the Jews, as interpreted by Ezra and the Scribes during the period of the Second Temple. They formed a league of brotherhood, admitting in their midst only those who in the presence of three members pledged themselves to strict observance of the law.

37. Talmud: Erubin 113.

as Kezef, Af, Heima, Mishbar, Mashhit and Mechaleh.[38] While the names are Hebraic, the idea was probably taken from Persian occultism. The Avesta mentions a similar number of *daevas* (demons) who were messengers of the arch demon Ahoriman. In Talmudic literature demons are known mostly by Aramaic names, for Aramaic was the language spoken among the Jews of Babylonia and Palestine at the beginning of the present era. They were designated as *ruchin* (spirits), *mazikin* (hurtful spirits), *malachei habalah* [39] (angels of destruction) and *sheidei* (Hebrew *sheidim*). A demoniac was known as a *gevar sheidyan* (man possessed by a demon). There was a morning spirit, Tehara, an evening spirit, Telena, and a night spirit, Lilin. They were governed by an arch demon Asmodeus [40] (Persian Aeshma).

According to the Book of Enoch,[41] demons originated from the union of the "fallen angels" with the "daughters of man." A Talmudic legend, which probably originated from a Persian myth, attributes their origin to the intercourse of Adam with the night demon Lilith.[42] Still another legend attributes the birth of evil spirits to the arch angel Samael. The latter is said to have cast lascivious glances on mother Eve; the issue of this union was no other than Satan, the tempter. The spirit governing the function of the eye in the Talmud is known as Bath Chorin, but she was of a rather benign nature.

Like earthly beings, spirits were believed to eat, drink, reproduce their own species and die.[43] They were able to assume either male or female form.[44] They could be differentiated, however, from earthly beings by the fact that they did not cast a shadow. Their dwelling place was said to be in the far north, from whence they flew to every corner of the earth.[45] Strong northern or northwestern winds were believed either to be invisible demons themselves or to carry the demons with them. The Hebrew and Aramaic *ruah*, signifying wind and spirit, probably originated from this belief. Peasants in the Baltic provinces to this day believe that the strong gusts of wind which blow in spring from the north and northeast are caused by the demons and witches of northern Finland and inflict people with rheumatism, colds, fever and sore eyes. The most fatal date is said to be the Day of Ascension, when the wind is thought to blow the hardest. Natives on this day take care not to go out of their houses.

38. Midrash: Exodus Rabba 41; Deuteronomy Rabba 3.
39. Talmud: (*a*) Berochoth 51a; (*b*) Kethuboth 104a; (*c*) Sanhedrin 106b.
40. Talmud: (*a*) Gittin 60a; (*b*) Shekalim 49b; (*c*) footnote 4*a*.
41. Enoch 90:7.
42. Yalqut: Genesis 25. Talmud: Erubin 18b.
43. Talmud: (*a*) Abboth d'Rabbi Nathan 37:7; (*b*) Hagigah 16a.
44. Talmud: Yoma 75a; Yebomoth 122a; footnote 43*b*.
45. Midrash: Psalms 41.

DEMONIC BELIEF IN THE NEW TESTAMENT

The belief in demonic possession was general among early Christians.[46] Demons are frequently mentioned in the New Testament as the cause of disease, the healing of which was effected by exorcism and prayer. Although the terms devil and demon are borrowed from the Greco-Roman world, which considered such spirits capable of being good or bad, the authors of the New Testament always considered demons as workers of evil.[47] The New Testament refers to disease of a diabolic nature and particularly to blindness due to possession.[48] The blindness of Bar-Jesus was diabolic in nature.[49] In James [50] and Revelations [51] demons are spoken of as spiritual beings hostile to God and having the power to inflict man with disease. They are stigmatized as unclean. The Chuch Fathers in their writing acknowledged their belief in pathogenic demons. According to Origen [52] (189-254 A.D.):

> It is the demons which produce famine, unfruitfulness, corruptions of the air and pestilence. They hover concealed in the clouds of the lower atmosphere. They are attracted by the blood and incense which the heathen offer to their gods. All diseases of Christians are to be ascribed to these demons. Chiefly do they torment freshly baptized children.

Origen testified that he saw people cured of dangerous diseases of possession, madness and other ills simply by calling on the names of God and Jesus.

Justin Martyr [53] (100-163), while forwarding to the Roman emperor the formula used to cast out demons, stated:

> Many of our Christian people healed a large number of demoniacs throughout the whole world. The magicians failed to heal such people. . . . Demons fly from the mere touch and breath of Christians.

Saint Jerome, describing the obsession which beset Saint Hilarion (291-371), remarked:

> Day and night did the demons change and renew their snares . . . as he lay down. How often did not nude women encircle him?[54]

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46. Matthew 9:32; 15:22. Acts 10:38; 19:12-16.

47. The New Testament frequently designated demons as unclean (Luke 6:18).

48. Matthew 9:28-29.

49. Acts 13:6.

50. James 2:19.

51. Revelations 16:14.

52. Cited by Cutten, G. B.: Three Thousand Years of Mental Healing, New York, Charles Scribner's Sons, 1911, p. 43.

53. Cited by Worcester, E.; McComb, S., and Coriat, I. H.: Religion and Medicine: The Moral Control of Nervous Disorders, New York, Moffat, Yard & Co., 1908, p. 298.

54. Vita St. Hilarioni, vol. 23-32; cited in Jerome, in Cyclopedia of Biblical, Theological and Ecclesiastical Literature, New York, Harper & Brothers, 1894.

Saint Anthony was also similarly attacked by the devil at night, which assumed the form of some warden who imitated a woman's gestures to deceive him.[53]

The Church Father Tertullian (160-220 A. D.) devoted a long chapter to a discussion of the nature and influence of evil spirits. He stated:

> Demons inflict disease and many serious mishaps on the body and violently visit man with a sudden and extraordinary aberration. Their wonderful subtility gives them access to the body of man. Their influence brings also corruption to the mind with a fury and foul madness.[53]

Saint Cyprian [52] (186-258) asserted that the demons cause luxation and fracture of the limbs, undermine the health and harass persons with diseases.

Gregory of Nazianzus (329-390) stated that pain is provoked by demons and that medicine is useless. Demoniacs were believed to be frequently cured by laying on a consecrated hand.[52]

For two hundred years after Justin Martyr there was hardly a Christian writer who did not confirm the demonic belief or who doubted the expulsion of the evil spirits from the sick by exorcism.

This superstition was equally spread among Talmudic rabbis. Some even claimed to have employed demons for various services. They called them by familiar Hebrew names, such as Jonathan or Joseph, and received useful information from them.[55] Rav Pappe [56] and Rabbi Joseph [57] ordered them to attend to their personal needs.

Abba Jose of Zaitor had a friendly spirit who gave him information about a harmful fellow spirit whose habitat was the water supply of the town.[58] This evil spirit was bent on harming the townsfolk.

In the Academy of Abaye there was a dangerous demon whom no one was able to dislodge.[59] One night a holy man arrived at the academy and not knowing of the presence of the evil spirit remained over night at the schoolhouse. His presence at the academy is said to have scared the demon away from the school, for he was never seen since that night.

Tradition attributes to Mohammed the belief that man in his journey through life is accompanied by an angel and a demon. The first leads him toward good and the last toward evil. This is an old Persian belief

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55. Talmud: (*a*) Yebomoth 122b; (*b*) Hulin 105b; (*c*) footnote 4*a*.

56. Talmud (footnotes 4*a* and 55*b*).

57. Talmud: Hagigah 16b.

58. Midrash: Leviticus Rabba 24; Psalms 20.

59. Talmud: Kidushin 29b.

and forms an important element in the moral philosophy of the Talmudic and Kabbalistic rabbis.[60]

Plotinus (fourth century), originator of neo-Platonism, claimed to have possessed a demon who was at his beck and call [61] and through whom he performed miracles.[62] Eunapius of Sardis stated that when Porphyrus became dangerously ill while traveling through Sicily and was "actually breathing his last," he was saved by the incantations of his master Plotinus. Porphyrus himself maintained that demons taught him how to expel malignant spirits from sick persons. He favored the use of Aramaic and Hebrew dialects in his incantations. These dialects were generally believed to be the most prompt means of casting out devils from demoniacs. The celebrated physician Paracelsus (1490-1541) imagined that he conferred with spirits a number of times.[62]

DEMONIC DELUSIONS IN THE MIDDLE AGES

Demonology, which in the first five centuries of the Christian era dominated all creeds and races, assumed in the Middle Ages proportions approaching insanity. The most terrible aberrations of the mind prevailed among people. Scores of girls in France showed evidence that they had been violated, and the violators were thought to be none other than incubi, demons who were supposed to assume the role of a lover or husband and who relegated to themselves the privileges of a husband. Hinkmar reported that such an illicit lover made amorous approaches to a nun and that it required priestly aid to separate them. Boys were robbed of their innocence by *succubi,* female demons (also known as *striga* or lamia). In the convent of Saint Benedetto, near the Italian city of Subiaco, a rose bush is shown into which the naked Saint Benedict threw himself from a high place in order to resist this

60. The Kabbalists built up a religious philosophy of their own with spirits as a part of the cosmic design of the emanistic system in which opposite currents of pure and impure powers fill the world and divide it between the Holy One and the serpent. Kabbalistic writers, however, did not resort to magic practices. They had confidence in prayers. "No one who indulges in magic practice," said Israel B. Eliezer, author of Sefer Hasidim, "will see good results."

61. In the Middle Ages demons occupied a prominent part in domestic life. In the absence of the housewife they were believed to attend to housekeeping and to swathe the babies in the crib. They frequented the cathedral at night and helped the completion of the church if it was in the process of construction. In rural Russia the *domevoi* (house spirit) is an important character in the folk-belief. He objects to certain kinds of animals or to certain colors in cattle and is in a general way propitiated and cared for. He in some way resembles the goblin in the English folklore. Among the Babylonian Jews of the fourth century the belief in *rucho debetha tovian* (a benevolent house spirit) appears to have been popular among the masses (Midrash: Genesis Rabba 20:28).

62. Cited by Magnus, H.: Der Aberglauben in der Medizin, Breslau, M. Müller, 1903, p. 71.

unholy temptation. Pope Benedict, commenting on the passage "the sons of God went into the daughters of men," [63] remarked: "The passage has reference to those demons who are known as *incubi* or *succubi*." The pope referred to writers most of whom admitted this to be the fact. The question of the actual existence of *incubi* and *succubi* whom the Romans identified with the *fauns* was seriously discussed by church authorities. Innocent III in 1484 set forth the doctrine of lecherous demons as indisputable.

In 1637 a formal discussion took place in Paris on the subject of whether the *incubi* could procreate their species. The pertinent point was that some of the women who believed themselves attacked by an *incubus* were not trying to disguise their illicit action; indeed, they showed definite marks of ruthlessness and bruises in the shape of hoofs that appeared on their breasts. The confessions of those who bore witness to the reality of *incubi* are numerous in the history of the inquisition and trials of witches.

This form of demonic obsession is not difficult to understand. It is well known that strong emotions frequently reflect in morbid imaginations, illusions and optical aberrations. Persons who repress their sexual functions are compensated by mental exaggerations of the sexual instinct. The perpetual night which enshrouds the blind seems to enable them to perceive much which is lost or confused in the vision of others. It is said that the philosopher Democritus deprived himself of sight in order that the vision of his natural eye should not interfere with the far more profound seeing power of his mental eye, for he believed that seeing with the naked eye was to see objects at a distance, while seeing with the mind's eye was to feel them close at hand and intimately. Repressed sexual function was the painful phenomenon not uncommon in the lives of saints and others attached to the church.

DEMONIC DELUSIONS IN MODERN TIMES

The belief in demons continued well into modern times, and among its adherents are found men of scholarly prominence. Burton, in his "Anatomy of Melancholy," gave assurance that they were never more plentiful than in 1600 A. D. Casper Schott [64] (1608-1666), the most learned man of his day, stated: "So many writers of high authority confirm the existence of demons that it is impossible to reject it." Levator remarked: "Many deny it because they never saw them, but nevertheless they are often seen and heard and they familiarly converse with men. Innumerable records, histories and testimonies in all ages, times and places evince their presence."

63. Genesis 6:4.

64. Worcester, McComb and Coriat,[58] p. 94.

This superstition was not altered with the dawn of the Reformation. The most prominent personality in the political and religious history of the last few centuries, Martin Luther,[62] was of the opinion that "No disease comes from God Who is all good and does good to all men. Disease comes from the devil." In a letter to John of Saxony, his elector, complaining about his frequent attacks of headache (which were probably due to eyestrain), he remarked: "My head is still slightly subject to him who is the enemy of health and all that is good; he sometimes rides through my brain so that I am not able to read or write." Luther's struggle against evil spirits was culminated by flinging an ink horn into the face of Satan. A black stain on the wall of his library in the castle of Wartburg testifies to this superstitious belief. This superstition did not decline under his fellow reformer, John Calvin. On the contrary, it attained stupendous proportions. Persons afflicted with chronic inflammatory diseases of the eye or stricken by pestilence were declared contaminated by the devil. They were carried to the church or chapel, where they were thrown on the floor until they became blind, died or were restored to life. Even the American Cotton Mather (1662-1728) was not emancipated from such beliefs. He took a young daughter of a fellow townsman into his house to see if she was really possessed by an evil spirit and decided in the affirmative. Salem has many a story to tell of possession and witchcraft.

INFLUENCE OF DEMONOLOGY ON RELIGION

It is difficult to realize at the present time the tremendous influence demonology has exerted on ancient and medieval philosophy and religion. The neo-Pythagoreans found demonology a convenient means to harmonize the philosophic conception of monotheism with polytheism. They ceased to be incompatible. Monotheism became the universal belief when subordinate gods and demons were identified with deities of a lower rank acting as intermediaries between the Supreme God and man.

RETROGRESSIVE EFFECT OF DEMONOLOGY ON MEDICINE

Demonology had a retrogressive effect on medicine. From the days of Hippocrates to the present period, with a few intermissions, medicine has declined. The noteworthy intermissions were during the life of Herophilus and Erasistratus in Alexandria and at about the beginning of the Christian era—the period of Celsus, Dioscorides, Galen and Aretaeus. The Romans, who succeeded the Greeks, placed medicine under the supervision of the gods and demons, and after them medical practice became a priestly function. The practice of medicine was confined to the monasteries and obscure chambers of the magicians. The declining effect of demonology on medicine is inde-

scribable. It checked its progress to such a disastrous degree that it took centuries to rescue it from the mass of superstition in which it became submerged.

It is not difficult to conceive how the uncultured man was led to the belief in demonic possession. Ignorant of the very rudiments of science and endeavoring to obtain the meaning of life, he was guided by his special senses. The appearance and behavior of one suffering from physical, and particularly from mental, illness, in which he no longer expressed his customary thoughts or spoke with his familiar voice, suggested to the rude philosopher that a spirit had entered that person and taken possession of him. Any one who watches the symptoms of hysteria, epilepsy or mania will see how naturally in the infancy of medical science demonic possession came to be the accepted theory of disease, and exorcism or expulsion of these demons, the ordinary method of treatment.

The uncivilized man could well understand diseases brought about by traumatic causes, as when he was bitten by the fangs of a wild beast or when he was wounded by the spear of an enemy, but he could not understand an ailment coming suddenly by itself, as it were. He was especially mystified when he beheld the sudden and rapid spread of epidemics that devastated his entire community. But even the more enlightened persons found it difficult to dissociate diseases from supernatural beings. The neo-Pythagoreans, for example, taught that the practice of medicine required a knowledge of occult science. "Any one who has not obtained a knowledge of demons is not able to practice medicine."

It is apparent that the effect of such teaching blocked the way to medical progress. It led to the most abominable medical superstition and quackery and made the physician subordinate to the magician. The healing art became an incompatible mixture of divination, witchcraft, herbs and a mass of nostrums, and the physician turned into a priest of the magic arts.

The center of such medical mysticism was once Alexandria, the great metropolis where the civilizations of the Orient and Occident met. It is indeed paradoxic that in the very place where scientific medicine originally gained a strong foothold through the investigations of Herophilus (born 344 B. C.), the discoverer of the optic nerve, and Erasistratus (300-250 B. C.), the great medical teacher and philosopher, the belief in supernatural healing gained great power. It is, nevertheless, a fact that in Alexandria theosophic medical mysticism became incorporated into a system of medical practice.

The influence of demonology on medicine became even more marked in the Middle Ages. Diseases such as the bubonic plague, Asiatic cholera and smallpox were ascribed to evil spirits. The great epidemic

of St. Vitus dance in the fourteenth century was attributed to the work of the devil, and trachoma, the scourge of the east, was imputed to a supernatural being.

A MODERN VIEW OF DEMONOLOGY

Superficially, the very attempt to ascribe the cause of disease to demonic possession is, to say the least, primitive. After reviewing the literature on the subject, however, I am of the opinion that the term possession was not always taken in the supernatural sense—that it was often interpreted as the entrance in the body of invisible beings of an unknown character. As early as the first century of the present era, Varro and Calumella [65] stated that disease originates from the inhalation into the system of certain invisible creatures. In the early part of the seventeenth century, when the belief in the demonic origin of diseases was still popular, John Astruc, physician to Louis XIV (1638-1715), in a review of the etiologic theories of syphilis, quoted from statements by Augustus Hauptmann and Christian Languis to the effect that the venereal poison is introduced into the body by a school of numerous, nimble, brisk, invisible living things of a very prolific nature, which, when once admitted, increase and multiply in abundance and spread to different parts of the body to inflame, erode and ulcerate the parts they fix on.

The same explanation was given earlier by the Jesuit Athanasius Kircher [66] for plague that prevailed in epidemic form.

Considering that these opinions were advanced at a time when the belief in demons was at its height, it is reasonable to suppose that there were rationally minded persons who conceived the idea of possession in a biologic sense.

That the meaning of the word demon was often taken in a rational sense may also be seen from the utterances of Talmudic teachers of the third century A. D. Abayye said: "They [demons] surround us on all sides as the earth does the root of the vine." [67] Rabbi Levi, quoting Rabbi Yudin, stated: "Every inch of space in the air is filled with

65. Cited by Preuss, J.: Biblisch-talmudische Medizin, Berlin, S. Karger, 1911, p. 159.

66. Athanasius Kircher (Scrutinium physico-medicum contagiosae luis, quae pestis dicitur, Rome, typ. Mascardi, 1658) announced that he had seen living worms in the blood of patients with plague (syphilis) through the microscope and evolved a theory of "living contagion" in which he anticipated the modern science of bacteriology (cited by Stubbs, S. G. B., and Bligh, E. W.: Sixty Centuries of Health and Physick, New York, Paul B. Hoeber, Inc., 1931, pp. 148-155).

67. (*a*) Midrash: Tanhuma Aikeb-Mishpatim; Psalms 17:55. (*b*) Talmud: Berochoth 56a.

demons who are ready to strike a person and inflict disease. The Lord has created angels to counteract the harmful effect of the demons." [67a] Abba Benjamin said: "If a man could see them, he would lack the strength to face them." [67b]

In the light of the science of bacteriology, these statements and others that will follow in the course of this discussion are significant. They sound more like scientific theory than legendary utterances. The mere fact that at a time when medicine was in its infancy invisible demons were ascribed as the cause of disease was a far advanced contribution to medical knowledge.

Of special significance is the second half of Yudin's statement: "The Lord has created angels to counteract the harmful effect of the demon." To use again a bacteriologic figure, this recalls a kind of benevolent microbe or phagocyte which destroys the malevolent bacteria. Thus one has a picture of pathogenic organisms and antibodies in the guise of demons and angels.

It is not my intention to convey the idea that certain persons had a prophetic knowledge of bacteriology as early as the beginning of the present era. The discovery of bacteriology is acknowledged to be the crowning glory of the nineteenth century. Still less is it my desire to convey the impression that ancient physicians were aware of the theory of phagocytes, which was advanced by Metchnikoff in 1882. I desire only to point out the mere fact that holding invisible beings responsible for the causation of disease before the microscope was known was an advanced step to progressive medicine.

The broader view of demonology in relation to medicine probably dates from the Greco-Roman period, when the term possession was applied by some writers to psychic and nervous conditions and not to general physical abnormalities. Aristophanes, for example, understood possession to mean raving madness. According to this view, the term demonic possession refers to a class of conditions characterized by sudden nervous excitability or by extreme mental depression. It also includes those conditions manifest by complete or incomplete loss of thought, reason, power of will or action and changes in the conduct and expression of the patient that could not be identified as of the person in normal health.

A classic example of demonic possession is that of epilepsy [68] (seizure), known among early medical writers as *morbus diabolicus*. Any one who has observed the symptoms of epilepsy can realize how natural it was in the infancy of medicine to accept demonic possession as the

68. Epilepsy, meaning seizure, is a relic of the ancient belief in demonic possession.

etiologic factor of epileptic manifestations.[69] The sudden onset, the staring eyes, the strange gestures, the froth-covered mouth, the fall, accompanied by a frantic and beastly voice, and the jerking of the body and twitching of muscles surely suggested to one to whom the natural order of things was not known that this strange action was the work of an evil spirit.

Even the modern psychiatrist finds it difficult to explain the phenomena of certain psychic disorders. To label a mental condition hysteria, melancholia, mania or psychosis does not disclose its cause. It merely refers to a class of conditions which are known to exist. To assume that the convulsion of epilepsy is caused by the mind acting on the body does not solve the cause of the condition. It merely tries to explain its mechanism. Insanity may arise in some cases from physical injuries or derangement of bodily organs. More often, however, the evil does not lie in the body but in the mind, and calling it by a certain name is merely begging the question. In all likelihood many of the conditions described in ancient and medieval writings as demonic were those which gave rise to symptoms of inexplicable phenomena.

MODES OF DEMONIC TRANSMISSION

In the light of the science of bacteriology and hygiene, the Talmudic description of pathogenic demons is of much interest. Their mode of attack, their predilection for certain organs, their prevalence in certain localities and during certain seasons of the year, the symptoms they produce and the measures taken for the prevention of their attacks and for cure might not be out of place in a modern book on hygiene.

Three different theories were advanced to explain the manner in which demons attacked persons. The most orthodox theory was that the spirit entered the body through the mouth or nose and sucked the blood of the person like a vampire. Another view was that the demon only discharged its venom into the diseased body or organ. Still another opinion was that of Jambilicus, who thought that the method of attack was chiefly by creating illusions and false images which frightened the person and caused him to see "chimerical powers." Jambilicus was of the opinion that demons caused only mental and nervous diseases.

Demons were said to be transmitted from person to person, from animal to animal and from animal to person. The one who occupied

69. Luke 9:39. Mark 9:18. Talmud: Yoma 83a and 84b. Trusen (Die Sitten, Gebräuche und Krankheiten der alten Hebrär, nach der heiligen Schrift historisch und kritische dargestellt, ed. 2, Breslau, W. G. Korn, 1853, p. 239; cited by Preuss [65]) expressed the opinion that some demonic disease in the New Testament referred to epilepsy as it is seen from Luke, "He teareth him and he foamed and gushed with his teeth."

himself with the practice of casting out spirits was, therefore, careful to keep his mouth closed while carrying out the exorcism lest the demon pass from the mouth of the patient into his own, a precaution taken by the modern physician when examining the mouth of a patient suspected of contagion. The Talmud states that one must not touch the eyes with unwashed hands because of the irritation caused by the demon Bath Horin.

Next to direct contagion, transmission through the air was considered important. According to Talmudic teachers, the air was literally filled with spirits, as is evident from the following citations: "They hover around the houses and fields." "Particularly are they numerous in the lower regions of the air." [70] "They [the demons] exceed us in number." "Each one of us is surrounded by them, a thousand on his left, ten thousand on his right." [71] "The whole legion of them are on the watch." [39a] "In public places [synagogues] the air is filled with them." [71b] "In time of epidemic one must be careful to isolate himself in his house and avoid the street." [72]

Demons were thought to be particularly malevolent during the night,[73] and for this reason in eastern countries it is still believed that exposure to night air produces disease. Extra care, therefore, is taken to keep bedroom windows tightly shut at night lest wandering demons enter and inflict persons with disease during sleep. It is recorded that King Charles of Spain had his confessor and two friars sit beside his bed while he slept to guard him against night demons. In the incantation bowls of the University of Pennsylvania, discovered at Nippur and translated by Montgomery,[74] there is a spell against evil spirits that enter the bed chamber and disturb domestic sexual life.

Water was also considered a medium for demons. "One that drinks water from creeks and pools, particularly at night," said Mar Samuel (a prominent physician of the third century), "takes a chance with his life because *shabriri* [75] [the demon causing blindness] dwells in those waters." Drinking water from uncovered vessels, particularly when exposed to night air, was considered hazardous.[76] "The one who draws water from wells located in dark places draws demons into his system.

70. Midrash: Genesis Rabba 20.

71. (*a*) Psalms 91:7. (*b*) Talmud: Berochoth 6a.

72. Talmud: Baba Kama 60b. Midrash: Ruth 1.

73. Hurmin, the daughter of Lilith, haunts the air at night (Talmud [22a]).

74. Montgomery, J. A.: Aramaic Incantation Texts from Nippur, University of Pennsylvania Museum, 1913.

75. Talmud: Pesachim 112a.

76. Talmud: Pesachim 3a. It was considered safe to drink from white vessels as one could see what one was drinking.

To walk on places where water [polluted] is spilled is dangerous."[39a] The avoidance of spilled water is reminiscent of the precaution exercised by modern people against contact with saliva or mucous discharges. It was strictly forbidden to drink water from one whose hands were not washed in the morning.[39a]

Oil was considered a powerful medium for disease. According to the Talmud one should not walk on oily places. Unsanitary places should be avoided, as most malignant demons were thought to inhabit filthy places, such as privies, drain pipes [77] and pits.[78] They also were abundant in decomposed animal and vegetable débris.[79] One should be careful not to cast food crumbs on the ground, as any kind of food was believed to allure demons.[80]

The swallowing of certain kinds of food, especially vegetables, was looked on with apprehension by ancient and medieval people. Blessing the food before the meal was originally a means of protection against evil demons that might be in the food. In the sixth century, Gregory the Great solemnly related that a woman having eaten lettuce without making the sign of the cross swallowed a demon, and when the devil was commanded to come out, it emerged and said: "How am I to blame? I was in the lettuce, and this woman, not having made the sign of the cross, swallowed me."[81]

Vacant houses, ruins and cemeteries were believed to be favorite rendezvous for evil spirits. Pilinius Secundus stated that he remembered a house in Naples which no man dared inhabit for fear of demons. Rabbi Nathan said: "One should not enter a ruin for fear of demons."[80b] In Italy haunted houses are known as *foliot*, and they are the fear of the community. Perhaps the prophet Isaiah was referring to such forlorn houses when he stated: "And their houses shall be filled with doleful creatures. Ochim and owls shall dwell there."[82]

The summer season (from *Tamanuz* 17 to *Ab* 9—about July 15 to August 15) was considered perilous to life and health because intense heat was the most favorable for the gathering of spirits. In the Talmud persons are warned to avoid the streets during the hot season of the year (particularly from 10 o'clock in the morning to 3 o'clock in the after-

77. Talmud: (*a*) Gittin 87; (*b*) Yebomoth 17; (*c*) Shabbath 69b.

78. Midrash.[70] Talmud.[77a]

79. Talmud: Hulin 105a.

80. (*a*) Talmud: Pesachim 3b; (*b*) Berochoth 3a and (*c*) 62b; (*d*) Shabbath 67a; (*e*) Gittin 70a; (*f*) Hulin 105; (*g*) Sanhedrin 65b.

81. Cutten,[52] p. 44.

82. Isaiah 13:24. When entering a cave or a vacant house, Arabs addressed the *jinn* as the "blessed one." As the familiar saying goes: "Talk of the devil and you shall see him."

noon) because the terrible demon Keteb meriri roamed in the atmosphere during that period.[83]

Persons weakened by disease were considered particularly susceptible to demonic attacks because it was believed that Satan always struck in time of danger when resistance was low.[84]

MULTIPLICITY OF DEMONS

Since the idea of demonic possession reduced the etiology of all disease into one important cause, apparently, the treatment of all maladies became condensed into one remedial measure. In reality, however, this primitive system of medicine was greatly complicated, for in order to make the spiritual cure effective the healer had to find out the names and natures of the spirits causing the sickness. This was not so easy, since there was an individual demon for each disease and symptom as well as for every organ, and these had to be cited in the incantation. To keep all them in the mind taxed the sorcerer's memory to the limit.

It must be borne in mind that before anatomy demonstrated the connection of the bodily organs to the brain and spinal cord and before physiology defined the function of the brain and cord as coordinator of the body, it was believed that every organ was controlled by a separate supernatural force, and these in turn were governed by a super force the function of which was to coordinate all the organs in the system. In the Book of the Dead of the Egyptians the human body is divided into thirty-six parts. The function of each organ or part was thought to be controlled by a deity. The eye, for example, was governed by the god Hathor, the ears by Assud, the lips by Amibus, the growth of the hair by Nei, the face by Re, etc. All these individual powers were governed and coordinated by Thoth, who supervised the functioning of the entire body. When spirits displaced the gods, their number greatly increased. Attempts were made to reconcile demonic healing with the rational method of Hippocrates, who diagnosed each condition on the basis of the humoral theory. The sorcerers tried to explain the differences in disease by advancing another fantastic theory; i. e., that there were separate demons not only for every disease but for every symptom of the disease.

NAMES OF PATHOGENIC DEMONS

The names of pathogenic demons originated in Babylonia[85] and Persia and are designated in the Talmud according to the diseases they produced, the organs they attacked or the symptoms they presented.

83. Midrash: Shohar Tobh 19.
84. Palestinian Talmud: Berochoth 54b.
85. Palestinian Talmud: Rosh Hashana 56a.

Frequently they were named after the localities in which they were said to be most numerous. Some of the demonic names in the Talmud arranged alphabetically are as follows:

Achaza (seizure),[86] the demon of convulsions.

Agrath bath Machlas,[87] a malicious spirit who haunted the night air and poisoned the water.

Alukah, a horse leech (blood sucker or vampire),[88] known among the Arabs as Aluk, the demon who caused anemia and emaciation; the demon of the world below.

Bath Chorin (the daughter of freedom),[89] a euphemistic expression for the demon who caused ocular disease.

Ben Nefilim,[90] the demon of nightmare in children.

Ben Temalyon, the spirit who produced St. Vitus dance.[91]

Bulmus, the demon who caused bulimia.[92]

Deber,[14] the fiend who caused heat exhaustion. This demon is probably similar to the Babylonian Nergal—the smiter.

Eshshata (fire),[93] the fever demon.[94]

Hama, the spirit responsible for eruption of the face.[95] The favorite place of this spirit was in the vessels containing oil.

Kardeyakus, the spirit of delirium tremens.[96] The habitation of this demon was in vessels containing wine.

Keteb Meriri, the demon of sunstroke.[97] This demon reigned during the hot summer months from 10 in the morning to 3 o'clock in the afternoon and was held responsible for many epidemics and deadly diseases caused by the hot winds of the tropical climates. God's protection was invoked against this malignant spirit.

Kinutructus, the demon who caused hydrophobia.

Ruach Kezarit, the evil spirit of asthma.[90a]

Quapa, or Kipa, the demon who caused indigestion and flatulence.[80d]

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86. Talmud: Shabbath 151b; Yoma 83a and 84a; Gittin 67b. The term *achaza*, or seizure, applies to sudden onset of disease. In the New Testament seizure is often applied to epileptic and nervous manifestations (Mark 1:32; 16:17-18. Luke 6:17-18).

87. (*a*) Talmud: Pesachim 112b. (*b*) Midrash: Yalqut Hadash Keshafim 56; (*c*) Numbers Rabba 12.

88. Proverbs 30:15. Talmud: Abodah Zarah 17a.

89. Talmud: Shabbath 109a.

90. (*a*) Talmud: Bekoroth 44b; (*b*) cited by Shor: he-Haluz, 1865, vol. 7, p. 17; 1869, vol. 8, p. 6.

91. The miracle worker Rabbi Simeon ben Yochai expelled that demon from the daughter of a Roman emperor (Talmud: Meilah 17b).

92. Talmud: Yoma 82.

93. Talmud: (*a*) Shabbath 66b; (*b*) Abodah Zarah 29a.

94. According to the Biblical commentator Rashi, this demon is called Kipa.

95. Shor, H. D.: Emonoth Tefeloth, in he-Haluz, 1869, p. 15.

96. Talmud: Gittin 67b.

97. (*a*) Psalms 91:3. (*b*) Midrash: Lamentations Rabba 1:3; footnote 87c. (*c*) Talmud: Pesachim 111b.

Kuda (Persian, Akhtya),[93b] a cruel demon who attacked women with disease during childbirth.

Nichpe, the demon of epilepsy.[87a]

Palga (half), the name for the demon attacking one half of the head (hemicrania); also known as Zarda.[98]

Pura, or Puta, the demon who caused forgetfulness (amnesia).[99]

Ruach Zenunin, or Aza,[100] the spirit of lust or abnormal sexual desire.

Shabriri (dazzling glare),[101] a euphemistic expression for the spirit who caused blindness; Shabriri deyoma, the spirit who caused day blindness and Shabriri delailya, the spirit who caused night blindness.

Sheiyah,[102] the storm demon of oxlike form dwelling in desolated houses.

Shibbeta (Persian Sabetach),[103] a female demon with long hands who caused croup in children. This demon was probably identical with Bucasi-asp, the Parsee demon with long hands, who lulled men to sleep and attacked them.

Shed Shel Beth ha Kissei[104] (the privy demon), who caused sickness to persons who inhaled the odor of human feces. This demon was also known as Bar Shirikai Pandai.[80d]

Ruach Tezazit (Persian Tusus), the spirit who caused madness.[105]

Yerokon,[106] the spirit responsible for chlorosis.

Yohane bat Retibi,[107] a malicious spirit who put difficulties in the way of women during labor. This spirit seems to be similar to the mythical figures Iotape and Letape mentioned by Pliny.

(Ruach) Zaraat[108] (etymologically, the spirit of eruption of the skin), the demon who inflicted persons with leprosy.

Ruach Zelhata,[109] the spirit who caused violent headache or meningitis, similar to the Babylonian demon Tin. The favorite place of this spirit was in the vicinity of palm trees.

Zerada, the demon of catalepsy.[109].

PATRON SAINTS OF DISEASES

In medieval times gods and demons yielded to saints. These were believed to possess the power of inflicting as well as of curing disease. The relation of saints to disease was usually determined by the manner

98. Talmud: (*a*) Gittin 68b; (*b*) footnotes 55b and 97c.

99. Siddur: Ben Amram 1:31b.

100. Talmud: Pesachim 111a. Midrash: Yalqut Torah 247.

101. Talmud: (*a*) Abodah Zarah 12b; (*b*) Gittin 69a; (*c*) footnote 75.

102. Isaiah 24:12. Talmud: Baba Kama 21a.

103. Talmud: Hulin 107b; Taanith 20b; Yoma 77b.

104. In Palestine privies were situated in isolated spots which haunted the imagination with specters of fear. A special incantation was prescribed invoking the protection of the guardian angels against the evil spirit hovering there (Talmud: Berochoth 60b and 62a).

105. Pesiqta, Parah 40. Palestinian Talmud: Yoma 45b.

106. Talmud: Yoma 84a.

107. Talmud: Sota 22a.

108. Talmud: Kethuboth 61b.

109. Thalmud: (footnotes 55*b* and 98*a*).

in which the saint died. For example, Saint Agatha was cruelly tortured before she was put to death, her breasts being cut off. Hence, the disease of female breasts was placed in her charge, and she became the patron saint of nursing women. Saint Apollonia had her teeth knocked out and her jaw broken. Hence prayers were directed to her to relieve toothache. Until the end of the sixteenth century the only recourse for the sufferers of certain ailments was to make a pilgrimage to the shrines of saints where holy men were present and furnished the sufferers with certain prayers appropriate to every disease. As late as the eighteenth century the hospital of the order of Saint Anthony of Vienna had a collection of relics of the afflicted who had received relief there.

The names of the saints associated with the diseases are as follows:

Ague was called St. Pernel's disease.

Ancylostomiasis, or hookworm, became known as St. Gothard's disease.

Chorea had five patron saints and was known as St. Anthony's dance, St. Vitus dance, St. Guy's dance, St. Modestus' disease and St. John's disease.

Delirium tremens assumed the name of St. Martin's evil.

Dental disease and toothache were called St. Apollonia's disease.

Epilepsy was named St. Avertin's disease. It was also known as St. John's evil and St. Mathurin's disease.

Erysipelas was known as St. Francis fire.

Gout was called St. Maur's disease.

Hydrophobia assumed the name of St. Herbert's disease.

Hemorrhoids was known as St. Fiacre's disease.

Intestinal colic was changed into St. Erasmus' disease.

Diseases of the legs and feet were under the supervision of St. Bechus and St. John.

Leprosy and cancer were known as St. Gete's disease. Cancer was also known as St. Gile's disease.

Diseases of childbirth and of children became known as St. Margaret's disease.

Diseases of the lungs and throat were named after St. Blasius (Blaise).

Diseases of the mammary gland became known as St. Agatha's disease.

Mania was connected with St. Dymphna's disease.

Measles became known as St. Lazarus' disease.

Ophthalmia was known as St. Clair's disease.

Plague was called St. Sebastian's disease.

Pellagra was identified as St. Aman's disease.

Pruritus was known as St. Main's evil.

Quinsy or sore throat was designated as St. Blaise's disease.

Rheumatism was designated as St. Gervasius' disease.

Ringworm became known as St. Aignan's disease.

Syphilis was named after the Biblical Job, hence it was called St. Job's disease. Primary syphilis, or the manifestation of a bubo, became familiar as St. Roch's disease. Secondary syphilis was known as St. Sement's disease.

Yellow fever was identified with St. Anthony's fire.

St. Valentine, in addition to his interest in lovers during the springtime, had special care of epileptics.

St. Vitus was the patron saint of stammerers. Stammering was known as St. Vitus dance of the voice.

St. Zachary was connected with dumbness.

St. Benedict [110] was the patron saint of all diseases.

PRIESTS, LAY EXORCISTS AND MAGICIANS

The priest's ritual consisted of prayers, divinations and incantations. He took the possessed person to the temple where he was placed before the gods and instructed in the mystic rites of propitiating the deity that punished him with sickness. "Only the gods that brought on the disease were the ones to remove it."

The custom of carrying the sick to the temple is an ancient one. It was first practiced among the Egyptians in the temples of Isis and Serapis. "Temple sleep" before the deities was conducive to recovery and health. The soul, which was believed to depart from the body during sleep, was in a better position to communicate with the divine power and ask forgiveness in the temple than when imprisoned in the body.

In ancient Greece maimed and disabled persons were brought to the temple of the priestly physician Aesculapius and were placed before his deified figure to be cured. Aesculapius is accepted as the patron saint of medicine.[111]

The custom of bringing the sick to places of worship was a progressive step from the practice of the ancient Babylonians. It must be remembered that, according to Herodotus, the Babylonians carried their sick to the public market places with the hope of receiving medical advice from passers-by who at one time suffered from a similar disease.

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110. Great faith was placed in the medal of Saint Benedict. It consisted of a round metal, on one side of which is the figure of the saint holding a cross in his right hand and the Holy Rule in his left hand. On the other side is a cross and around it the letters "C.S.P.B.," which stands for "Crux Sancti Patris Benedicti" (The Cross of the Holy Father Benedict). Saint Benedict was considered by the church the most potent *efugator daemonu*. His name was evoked in cases of spiritual peril and deadly attacks.

111. Epidaurus, the reputed birthplace of Aesculapius, grew into the most popular health resort of ancient Greece. It became a medical center. The students were trained for the dual calling of priest-physician. One of the essential methods of treatment was the "temple dream," during which the gods manifested themselves in the form of serpents who visited the patient and licked the diseased portion of the body. The two daughters of Aesculapius, Hygeia and Panacea, were also deified. The former became the patron saint of preventive medicine, and the latter, of drugs that cure all diseases.

During the outbreak of an epidemic, dozens of possessed persons were carried to the temples. They were left on the floor of the holy places until they died or until the demon was expelled.

In the twelfth century patients were brought to shrines. The shrine of the Cathedral of Cologne is claimed to have obtained the skulls of the Three Wise Men of the East, and sufferers from all over Europe came there to be treated. The Church of Saint Ursula was filled with relics of her 11,000 virgin martyrs and has drawn to its shrine thousands of troubled persons searching for cures. This practice continued well into modern times. In the Holy Land a flourishing business is carried on by ecclesiastics selling all sorts of spurious relics. The famous shrine at Lourdes in France [112] and at Saint Anne de Beaupré in Canada are still visited by credulous sick from Europe and America. The sexton of an ancient synagogue in Cairo pointed out to me a room in the rear of the edifice where the sick were formerly brought to receive religious rites.

It is reported from time to time by travelers that exorcism is still practiced in the east.

There is no record that Jewish priests in Biblical times, however, occupied themselves with the rite of exorcism or other forms of healing. To them were assigned the duties of health officers who supervised patients suffering from leprosy and gonorrhea, viewed by the writers of the Pentateuch as communicable diseases.[113] The practice of exorcism among the Hebrews was probably in the hands of laymen who claimed power over nature and the invisible which their fellow beings did not possess.

The exorcist seems to have belonged to a special healing cult. When called on to exercise his calling, he always appeared in a dignified form. He was, as a rule, attired for the occasion in a bright-colored mantle ornamented with shiny decorations. He never failed to impress the patient with his authority and power. The spell, as a rule, began as follows: "With the wand of Moses and the plate of Aaron and the seal of Solomon and the shield of David and the Mitre of the high priest, I perform this spell." This was followed by conjuration of the evil spirit to leave the body of so and so, the son of so and so. In one of Montgomery's collection,[114] the spell began, "I, Paback, come clad in iron and fire vested with garments of Hermes the Logos and my strength is in Him Who created heaven and earth."

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112. It is reported that the late Charcot, who established the Salpêtrière Hospital, sent 50 or 60 patients to Lourdes every year. He was firmly convinced of the healing power of faith.

113. Leviticus 13: 1-59; 15: 1-33.

114. Montgomery,[74] p. 67.

The magician commenced his magic rites by inspiring fear in the patient and faith in his own (i. e., the magician's) ability to cast out the demon. The fear was intended to make the patient forget his trouble. The conjurer often disguised himself as a tiger or a lion by putting on the skins of these animals. He roared, shrieked and danced in order to distract the patient from his painful disease. He exhibited morbid objects, such as parts of a corpse, a skeleton or a snake entwined around his own body. After the patient was completely unnerved, he began his charm by mumbling a mystic formula. Spiritual healers never failed to leave with the patient something to occupy his mind, in the form of a suggestion or some kind of an amulet. The last act was assurance that the painful sickness would soon disappear.

Frequently the suggestion took the form of playing a musical instrument. Thus when the evil spirit troubled Saul, he summoned David to play his harp.[115] The value of music in psychic disorders was long recognized by the celebrated physician Aretaeus and is still advocated by psychiatrists.

Among the Dakota Indians, the medicine man, when called to expel an evil spirit, shouted *he le li lahe* as soon as he approached the sick person. This utterance was accompanied by beating of drums and rattling of beads and was followed by sucking the afflicted part until the spirit was supposed to have taken flight. The neighbors then fired guns from the tent at the departing spirit.

STIMULANTS USED BY OCCULT HEALERS

It was the custom of medicine men, before communicating with the occult forces, to partake of stimulating substances. Before performing the act of conjuration, the Mexican conjurer ate certain round seeds known as *ololihuqui,* which made him see strange phantoms. The Zapro Indians of Ecuador prepared drinks with *huamto* as a base, which put the sorcerer in a state of coma. The medicine man of the Inca Indians of Peru used cocoa to inspire him. These stimulants induced exhilaration, which led to shouting and dancing. When thoroughly exhausted and in a pool of perspiration, the magician fell into a trance ready to communicate with the spirits and to receive from them information as to the cause and cure of the evil.

The Pythians of the Oracle of Delphi were overpowered by prophetic delirium when they ate the leaves of the laurel (plant of Apollo).

According to Herodotus, Scythian women prophesied only while in a state of intoxication brought on by inhaling vapor of certain flax seeds roasted on red hot stones. Various preparations of Indian flax are still utilized by aborigines for the same purpose.

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115. I Samuel 26: 23.

CONDEMNATION OF EXORCISTS

In Greece men of no less distinction than the agnostic Epicurus and the orator Aeschines were sons of women who lived by the profession of exorcism. Both were bitterly reproached, the first by the Stoics and the second by Demosthenes, for having assisted their parents in occult practices.[116]

Celsus censured the exorcists of his day in no mistaken terms. "There are," he said, "often seen every day on the public square men taught among Egyptians who for a copper perform wonderful miracles, drive out spirits by their breath from those who are ill, evoke the souls of heroes." Then he asked: "Is it reasonable to conclude that they are the sons of God or should we not rather think them wretched and wicked men?" A similar condemnation of exorcism was delivered by the celebrated physician of the Middle Ages, Maimonides, the sage of Cordova.[117]

Undoubtedly there were always rational minds who opposed superstition.[118] The public at large, however, had the utmost confidence in spiritual healers. They considered exorcism as a divine gift and those who practiced the mystic art as supermen, versed in supernatural secrets.

METHODS USED TO CAST OUT DEMONS

The method of casting out demons varied in accordance with the different primitive philosophies and conceptions. In Assyria, as pointed

116. Alexander of Tralles stated that even Galen believed in the efficiency of incantation to cure disease. He quoted Galen as saying: "Some think that incantation is like old wives tales, as I did for a long time, but of late I became convinced of its virtues." Cutten,[52] p. 196.

117. To Maimonides, demons as mentioned in the Talmud are only figurative expressions of physical plagues. "Many pious Jews," he stated, "believe in the reality of witches and demons, thinking that they should not be made the object of worship for the reason that it was prohibited in the Torah, but fail to see that the law commanded to banish all such things from sight because they are all falsehood and deceit as is the idolatry with which they are connected (Moreh Nebhukhim 3: 29-37). Ibn Ezra (Commentary on Job 1: 6) was of the same opinion.

118. In the seventh century exorcism in any manner or form was prohibited. Theodore, the seventh archbishop of Canterbury (602-690), condemned those who invoked fiends and so caused the weather to change. Charlemagne (742-814) decreed the punishment of death to those who by invoking demons tormented their fellow creatures with disease and misfortune, such as destroying the fruit of the trees and drying the milk of cows and exciting tempests in the atmosphere. It is evident that while demonic practice was prohibited, it was firmly believed in. James I (1566-1625) enacted a statute that all persons invoking evil spirits or persons consulting, entertaining, employing, feeding or rewarding those who claimed to have any transaction with evil spirits be condemned to death. Criticism of demonology as a medical factor appeared first in books of the eighteenth century. The authors boldly denied supernatural powers over demons.

out previously, diseases were ascribed to occult influences. Divination was used to find out the name of the possessing demon, who was then exorcized by the use of incantations. Often the appeal was made directly to the gods Marduk and Ea. Sometimes, instead of employing magic formulas, the demon was expelled by making its image and then mistreating it. Such images have been discovered in Assyrian palaces. The incantation used by the exorcists was addressed to the possessing spirit. It was expressed in a commanding and forceful language, such as "Get thee back, thou enemy, who dost cause pain to so-and-so, the son of so-and-so," or "Flow out, thou poison, upon the ground." The mere calling the demon coward or weakling had a subduing effect on him. Thus the spell often read, "Thou art weak, not strong; a coward and dost not fight; blind and dost not see."[119] In Egypt the demon was rendered impotent by the mere utterance of the ineffable deities Horus or Seth.

In the Papyrus Ebers [120] it is stated that demons were scared away in the name of the god Re. Thus to expel the demon causing leukoma of the cornea (white spots on the eye), the following charm was recited:

> It is thundering in the southern sky. Since evening there is rough weather in the northern sky, [as] corpses fell in the water and Re's crew are landing at their shore because the heads fell into the water, who shall bring them [who shall] find them. I have brought your heads, I have attached [them to] your necks, I have fastened your cut-off [head] in their place. I have brought your [i. e., Re's crew] to expel affliction [caused] by a god, by dead man or woman.

It is said that this charm was recited over the gall of a tortoise, which was pounded with honey and applied to the eyelids.

An Egyptian remedy to expel the demon of blindness is cited in the Papyrus Eber,[120] for which the author vouched curative power. ("Do [it] and thou shalt see really excellent.") The ingredients consisted of the humor of a pig's eye with stibium and bees' honey. The remedy was ground fine and poured into the ear of the patient, so that it would reach the demon immediately. Then the following charm was recited twice: "I have brought this which was applied to the seat of yonder and replaces the horrible suffering."

It appears from the following incantation that the Egyptians believed remedies were also possessed by demons. Thus they tried to influence

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119. Dawson, W. R.: Clio-Medica, The Beginnings: Egypt and Assyria, New York, Paul B. Hoeber, Inc., 1930, p. 62.

120. The Papyrus Ebers: The Greatest Egyptian Medical Document, translated from W. Wrezinski's hieroglyphic transcript by B. Ebbell, London, Oxford University Press, 1937, (*a*) p. 70; (*b*) p. 73.

one demon to expel a fellow demon. In the Papyrus Ebers [120b] is cited the following formula for the cure of cataract:

> Come Malachite, come Malachite, come thou green one, come discharge from Atumis' eye, come fluid that has come out of Osiris, come to him and expel for him water, matter, blood, dim light, blindness, blear-eyedness, afflictions, [caused] by God, by dead man or woman, all kinds of purulency, all evil that are in these eye.

This charm was recited over (the remedy) malachite "pounded with honey with them is pounded nuts is applied to the eye." This prescription is postscripted "really excellent."

In the medical texts of Assyria disease was personified. The following incantation, deciphered by R. Campbell Thompson [121] for one suffering with a foreign body in the eye, shows that the illness or spirit causing the condition was appealed to by the exorcists.

> O failing eyes, O painful eyes, O eyes sundered by a dam of blood! Why do ye fail, why do ye hurt? Why hath the dust of the river come nigh you, or the spathe of the date-palm whereof ye have chanced to catch the pollen which the fertilizer hath been shaking? Have I invited you, Come to me? I have not invited you, come not to me, or ever the first wind, the second wind, the third wind, the fourth wind cometh to you!

This charm was recited after a magic thread of red wool with seven knots had been tied around the eye.

One of the Aramaic and Mandaic magic bowls deciphered by Dr. Cyrus H. Gordon may serve as an illustration of the nature of the magic formulas against diseases used in the early centuries of the present era. The incantation is directed particularly against "Merattetiel the demon that terrifies and shakes all members of the body of the sons of man. . . . and the evil spirit that sits on the brain and makes the eyes weep and causes inflammation and suppuration and fluid of the eyes and imagination and swelling of the eyes." The charm closes with an adjuration to the evil spirit as follows:

> I adjure you and make you swear that you depart and go forth from him [ye from] the two hundred and forty-eight members of his body. May they not stand in his standing place nor lie in his sleeping chamber from this day unto eternity in the name. . . . By the Lord and the great throne belonging to the Master and Yahweh, the ineffable name that was revealed to Moses in the bush in this. . . .[122]

In the third century the magic formulas to drive out demons were expressed in the most meaningless and unintelligible utterances. For

121. Thompson, R. C.: Assyrian Medical Texts, Proc. Roy. Soc. Med. (Sect. Hist. Med.) **17**:1, 1924.

122. Gordon, C. H.: Aramaic and Mandaic Magical Bowls, Arch. Orient. **9**: 88, 1937.

example, among the Jews of Babylonia the conjurer mumbled *basbasiya, masmasiya, kaskasiya, sarlei, v'amarlei* to banish a demon causing eruption of the skin. These were supposed to be the names of benevolent spirits.[80d]

In Greece the following mystic formula was drawled out for internal disease: *adaxi kataxi aie tetpae saujauejues aidav.* These strange words were said to be inscribed on the temple of Artemus and their meaning, according to Androcydes, was "darkness, light, earth, air, sun, and truth."[123]

For driving out a night demon, the Talmud suggests the formula *Lul sophon, aninron anivdifon* (between stars I set, between lean and fat I went).[124]

Marcius Parvius Cato, a Roman censor who also practiced medicine, recited the following when he desired to reduce a dislocation: *Hanat banat ista pista sista daminata.*[125]

When a person got a bone stuck in his throat, in the early days of Christianity, the physician was advised to seize the patient by the neck and cry out in a loud voice: "As Jesus drew Lazarus from the grave and as God has drawn Jonah from the whale, thus Blasius the martyr and the servant of God commands the bone to come up or down." The Talmudic method was for the sorcerer to secure a similar bone, place it at the back of the neck and recite *Had had nahis bala, bala nahis had had.*[80d]

The babbling of sick babies was interpreted by conjurers as the expression of demons through the mouths of babies, the meaning of which could be interpreted only by the conjurer, who replied to the sounds in a similar meaningless manner.

Occasionally, instead of reciting a magic formula a message was sent to the possessing demon. The mystic formula was written on paper, and the patient was ordered to swallow it. Often the name of the demon was written down and burned in order to expel him.

Prayer[126] and the ineffable name inscribed on parchment and carried about the person appear to have been prophylactic and therapeutic measures of Hebrews of that period.[127] Miracles were expected

123. Cited by Magnus, H.: Superstition in Medicine, authorized translation from the German, edited by J. L. Salinger, New York, Funk & Wagnalls Co., 1905, p. 105.

124. Talmud: Pesachim 112; Abodah Zarah 12.

125. Preuss,[65] p. 165.

126. Talmud: Berochoth 9b.

127. The Persians had a similar belief with regard to the word *Armuzd.* "The one that pronounced *Armuzd* with meditation is safe from the *daeva*" (Shor.[95] 1865, p. 18; 1869, p. 13).

to happen by invoking the name of the ineffable or by reciting the names of angels or patriarchs.

The Essenes at the beginning of the Christian era believed that the contemplation of God enabled one to acquire divine powers to ward off misfortune and to restore health to incurable persons, even to the blind, deaf and lame. Prayers and mystic symbols were employed when disease had overtaken a member of the community.

The Pharisees were averse to the use of mysticism on diseased persons. The observation of the law they held was the best protection against evil spirits. Thus said R. Yohannan: "One may cure diseases with reading of the law." R. Yehushua ben Levi asserted that reading a verse of the Bible is the best prophylactic against physical ailment. "The reciting of a prayer morning and evening and particularly the shema [proclaiming the unity of God] serves as a protection against evil powers," is another Talmudic statement.[128]

Despite the repeated injunction in the Old Testament against sorcery, there are scattered instances of persistence of rites allied to magic. The putting of *tphilin*[129] on the head and arm and the affixing of *mezuzoth*[130] on the doorposts and the wearing of *zizith*[131] have no direct reference to magic. The parchment inscriptions concealed in them contain portions of the Pentateuch relating to the Unity of God and certain precepts. There is no doubt, however, that the Hellenic Jews regarded *tphilin* as an amulet. The Greek name of *tphilin* (phylacteries) indicates amulet.[132]

Isaiah refers to crescent-shaped charms, *saharonim*,[133] around the necks of men, women and children and even camels.

Josephus had seen a certain Eliazer who, in the presence of Emperor Vespasian, his sons, captains and soldiers, released persons of demonic

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128. (*a*) Deuteronomy 6:4. (*b*) Talmud: Berochoth 5a.

129. Deuteronomy 6:8.

130. Deuteronomy 6:9.

131. Zizith (fringes at the edges of garments) were also regarded by some as a protection against evil spirits (Deuteronomy 6:4.9. Numbers 16:38. Talmud[128b]). The Persians used an amulet on the right arms of children who would not listen to their parents. Such children were suspected of possessing evil spirits by the Persians (Shor,[95] 1865, p. 18; 1869, p. 13). Alexander of Abonouteichos stated that the pestilence which devastated Italy in his days was checked by affixing at the doorposts the words "Phoebus, the hair unshorn dispels the clouds of disease." Demonic figures were set up by the Babylonians at the gates or buried beneath the thresholds of houses to frighten demons away.

132. Targum: Canticles 7:3. Midrash: Genesis Rabba 35. Talmud: Menuchoth 33b. In Babylonia a similar use was made of phylacteries. Layard discovered such small receptacles inclosing figures of animals and human beings buried under the houses.

133. Isaiah 3:18. Amulets are known in the Talmud as *pitka* (Talmud: Sanhedrin 20b) or camea (Talmud: Kidushin 73b).

possession by placing a magic signet ring in front of their noses which drew the demon out through the nostrils. He adjured the demons not to return by reciting incantations composed by King Solomon.[134]

The theory of *similia similibus curentur* appears to have entered into ancient medicine. Pliny prescribed for ophthalmia the hanging around the neck of the right eye of a frog if the left eye was affected and the left eye of a frog if the right eye was affected. An amulet roughly made in the form of an eye was the sign of Ra, the sun god, symbolizing his all-seeing power. It was called "the eye of Osiris" and was placed inside the body during the process of embalming as a protection against demons. Its function was to watch the soul and guide it through darkness to the light beyond. A large eye was usually painted on the beams of ancient Egyptian sailing vessels to protect them against demons. In the churches of foreign countries wax or silver eyes are still displayed on the walls in front of worshipers. A relic of the ancient belief is the form of an eye set in a pin which is worn in a scarf or attached to a dress.

USE OF AMULETS AGAINST EVIL SPIRITS

Demons were supposed to fear amulets. For this reason such emblems were tied on the necks or on the affected parts of diseased persons. They were thought to be particularly effective when the emblem was made in the form of an image. When the Philistines, after capturing the Ark and placing it in the Temple of Dagon, were smitten with hemorrhoids, they filled the Ark with images of tumors and mice and followed the direction of their priests, who believed that by such means they would be cured from the dreadful disease with which they were infected.[135]

The ancient magical *abracadabra*[136] was thought to be effective against demons for both prevention and cure. The word was divided into syllables, written on parchment and arranged in the shape of a cone, the base of which was directed upward. The parchment was then placed

134. Josephus mentioned the burning plant baarath, found at the northern shore of the Dead Sea, which has the power to drive spirits out as soon as they are brought in contact with its vapor (Josephus, F.: The Jewish War, edited by S. Burder, Boston, S. Walker, 1833, book 7, chap. 6). Rabbi Yochanan ben Zakai, a contemporary of Josephus, alluded to the practice of exorcism and the use of burnt roots of certain herbs to expel demons. The patient must be surrounded by water.

135. I Samuel 5:6.

136. This formula was first mentioned by Serenous Sammonicus, physician to Emperor Caracalla, whose work "De Medicina Praecepta" was admired by Emperor Alexander Severus. It is erroneously said that *abracadabra* is a cabalistic symbol and is a corruption of the Hebrew Habraha Dabar (bless the object). The Kabbalah has nothing to do with it.

in a metal container and tied to the neck of the person. In Talmudic times the word *shabriri* [137] was used in a similar way as a preventative and cure for blindness and was followed by the formula: "My mother told me to beware of *shabriri.*"

The practice of circumcision among primitive people was, in the opinion of anthropologists, a form of sacrifice to propitiate the gods to safeguard them against unclean spirits.[138] The newborn baby up to the time the ceremony took place was considered to be under demonic control. It is customary among orthodox Jews to affix certain mystic incantations on the walls of the lying-in room *(shir hamaloth)* soon after the birth of a child to protect the mother and child from evil powers.

The ceremony of baptism in the early Christian church was accompanied by a formula of exorcism, which is still practiced by officiating ministers of the Russian Orthodox, Roman Catholic and German Evangelical churches.

Infant baptism originated from the idea that until that time the child was in the power of Satan. The Greeks used to adorn the crib of the newborn with pictures of the sun or moon. Such symbols appear to have been universally accepted as protection against evil powers.

The following amulet against ophthalmia is taken from Marcellus (380 A. D.) and cited by Berdoe: [139]

Write on a clean sheet of paper ορβαικ, and hang this round the patient's neck, with a thread from the loom. In a state of purity and chastity write on a clean sheet of paper φυρφαραν, and hang it around the man's neck; it will stop the approach of inflammation. The following will stop inflammation coming on, written on a clean sheet of paper: ρουβοε, ρνονειρας ρηελοε ω • καντεφορα και παντες ηακοτει; it must be hung to the neck by a thread; and if both the patient and operator are in a state of chastity, it will stop inveterate inflammation. Again, write on a thin plate of gold with a needle of copper; do this on a Monday; observe chastity; it will long and much avail.

The following approved famous spell for sore eyes is related by Cotta [140]:

By many honest testimonies it was a long time worne as a jewell about many necks, written in paper and enclosed in silke, never failing to do sovereigne good when all other helps were helplesse. No sight might dare to reade or open. At length a curious mind, while the patient slept, by stealth ripped open the mystical cover, and found the powerful characters Latin: *"Diabolus effodiat tibi oculos impleat foramina stercoribus.*

137. Talmud (footnotes 75 and 101*a*).

138. Barton, G. A.: A Sketch of Semitic Origins, New York, The Macmillan Company, 1902, p. 100.

139. Cutten,[52] pp. 168-169.

140. Cutten,[52] p. 181.

Ambulatory female medicists who cured all diseases by charms were common among early Germans. The following charm was suggested for diseases of the eyes:[141]

> Three maidens once going
> On a verdant highway;
> One could cure blindness,
> Another cured cataract,
> Third cured inflammation;
> But all cured by one means.

The New Testament discloses that the most extensive practice of spiritual healing existed in Palestine. Jesus said: "If I through the finger of God cast out devils by whom do your sons cast them out?" According to the Book of Acts, Bar-Jesus and Simeon Magus bewitched even gentiles of foreign lands.[142] In the Greek papyri of the Christian period Jewish magic is frequently mentioned. Various anagrams and ineffable names, quotations from the Scripture and the names of Solomon and Moses are some of the magic figures. Moses was identified by the Greek Jews, who were anxious to blend their Bible with Greek philosophy, with Hermes-Thot and was regarded as the teacher of Orpheus.

EXORCISM IN CHURCH RITUALS

The Hebrew ritual, however, ignores entirely the rite of exorcism of possessed persons. It contains only prayers for the sick and disabled.[143]

In the Roman Catholic ritual the rite and form of exorcism were long preserved. While the patient was kneeling, the one possessed with the authority of exorcism placed the figure of the cross on the possessed person, sprinkled him with the holy water and with his right hand on the patient's head recited the following formula:

> I exorcise thee, unclean spirit, in the name of His Holiness, tremble, O Satan, thou enemy of the faith and thou foe of mankind who hast brought death into the world, who hast deprived man of life and who hast rebelled against justice, thou seducer of mankind, thou root of evil, thou source of avarice, discord and envy.

The old liturgy of the Church of England also contained a formula of exorcism which read as follows:

> I command thee, unclean spirit, in the name of Holy One, that ye come out and depart from these infants. . . . ye accursed spirits remember your sentence,

141. Cutten,[52] p. 257.

142. Acts 13: 6.

143. "Oh, may it be Thy will eternal, my God and the God of my fathers, to save me this day and every day alike from the ignorant and from the arrogance from evil men and from evil associates, from evil neighbors, from evil occurrences and from Satan that seeks to destroy."

remember your judgement, remember the day to be at hand wherein ye shall burn in fire everlasting prepared for you and your angels; and presume not henceforth to exercise any tyranny towards these infants. . . .

Incantations to drive out demons are also found in the Koran.[144]

PHYSICAL REMEDIES TO EXPEL DEMONS

Oliver Wendell Holmes said:

There is nothing men will not do, there is nothing they have not done, to recover their health and save their lives. They have submitted to be half drowned in water and half choked with gases, to be buried up to their chins in earth, to be scarred with hot irons like galley slaves, to be crimped with knives like cod fish, to have needles thrust into their flesh and bonfires kindled on the skin, to swallow all sorts of abominations and to pay for all of this as if to be singed and scalded were a costly privilege, as if blisters were a blessing and leeches a luxury. What more can be asked to prove their honesty and sincerity.

To no other system of medicine are Holmes' remarks more applicable than to that of demonic healing.

Some of the practices imposed on the sick were of the cruelest kind. Vigorous rubbing and fumigation with suffocating and offensive vapors were administered. Inquisitional instruments of torture, defying description, foul and loathsome substances, such as the dung of animals and birds, urine, the liver of toads and blood of rats, were forced on the poor sufferer. The rationale of such barbarous treatment rested on the supposition that the demon would find such grotesque measures even more distasteful than the patient himself and would be forced to leave the body of the possessed person. The cruelty perpetrated on the insane during the Middle Ages in the attempt to expel the evil spirit causing the insanity forms one of the darkest blots on the pages of medical history.

Occasionally surgical measures were resorted to. Probably the oldest surgical operation was that of trephining the skull. Numerous trephined skulls dating from prehistoric times have been discovered. The object for which a hole was made in the skull was to permit the passage of the incarcerated demon from the body of the possessed person. The trephining was done with a blunt instrument. The removed bone was used as an amulet by other persons to ward off diabolic diseases.

144. The Koran contains two formulas against evil spirits, one of which reads as follows: "Say, I fly for refuge unto the Lord of the daybreak that he may deliver me from the mischief of those things he hath created; and from the mischief of the night when it cometh on; and from the mischief of women blowing on knots; and from the mischief of the envious, when he envieth." (Al Koran, chap. 113.)

Palatable substances to men were sometimes considered offensive to evil spirits, as is seen from the following Assyrian spell cited by Dawson:[145]

I make a spell against thee with the efai-plant which injures, with onions which destroy thee and with honey which is sweet to the living and bitter to the dead.

This charm was addressed to the spirit of a dead man which frightened the patient.

The following charm from Campbell Thompson's collection is intended for external application for a person troubled with some form of ophthalmia:[146]

In Heaven the wind blew and brought blindness to the eye of the man: from the distant heavens the wind blew and brought blindness to the eye of the man. Unto the sick eye it brought blindness; of this man his eye is troubled, his eye is pained. The man weepeth grievously for himself. Of this man, his sickness Ea hath espied and said, "Take pounded roses, perform the charm of the Deep, and bind the eye of the man." When Ea toucheth the eye of the man with his holy hand, let the wind which hath brought woe to the eye of the man go forth!

Herbs, seeds, fruit and drugs frequently supplemented the excrement pharmacopeia, but these were more for the appeal to the imagination than for their healing virtues which they were supposed to possess.[147] Mandrake, for example, was one of the plants first said to possess therapeutic virtue. It was prescribed as a hypnotic and aphrodisiac, but its therapeutic action was ascribed to magical powers. It was administered to the sick because its root appeared to have a resemblance to a human form. Tales were at large that when the root was pulled out from the earth it groaned and shrieked so dismally that if the person who dug it up did not use cotton or wax in his ears he was in danger of death.

Saint Hildegard of Bengen (1136) exorcised with Mandragora, the demon of love. Johanna Rhode (1526) suggested the following

145. Dawson,[119] p. 23.

146. Stubbs, S. G. B., and Bligh, E. W.: Sixty Centuries of Health and Physick, New York, Paul B. Hoeber, Inc., 1931, p. 18. Thompson,[121] p. 32.

147. The gathering of medicinal herbs was accompanied by incantations. Thus *verbena* in Latin means "a sacred bough," and when the herb was picked it was addressed as "holy herb," as is evident from the following litany:

"Hail to the holy herb growing on the ground,
On the mount olives first wast thou found.
Thou art good for many an ill and healest many around.
In the name of Jesus, I lift thee from the ground."

Even when the patient was treated by drugs, the idea of possession was never entirely absent. The physician could never forget that his craft originated in magic. Thus in the Papyrus Eber the prescriptions are headed by "remedies to drive out, to banish, to destroy, to terrify or to kill" diseases.

prayer for a woman whose domestic happiness was interfered with by demons: "Mandragora, I pray to thee to keep my cruel husband from doing harm to me."

From time immemorial mandrake was sought as a sexual stimulant in cases of impotence. Rachel, who desired to have children, purchased it from Leah on condition that Jacob spend the night in her tent.

Mandrake has played a part in Roman medicine. Dioscorides, an army surgeon of Nero, mixed it with wine and used it as an anesthetic for surgical operations. Shakespeare's Cleopatra, yearning for her far away lover, used it as a hypnotic. She said: "Give me to drink mandragora that I might sleep out the great gap of time my Anthony is away."

Red wine was used for two purposes: to intoxicate the demon so that he would not suck the blood of the patient and to replenish the blood he lost. The red color of the wine was supposed to make up for the lost blood. Beans were ordered for diseases of the kidneys because the bean resembles the shape of the kidney. Walnuts were prescribed for headache and meningitis because the kernels have some resemblance to the convolutions of the human brain. Eyebright was a flower used in the treatment of diseases of the eye because its blossom resembles the pupil.

BELIEF IN PLANT SOUL

The virtue of plants and herbs was also ascribed to the belief that plants and herbs possess spirits;[148] thus one kind of spirit was employed to combat and eject another kind of spirit.

The corn spirit, which often took the form of a domestic animal, is an interesting example. Farmers in Eastern Europe still claim to see the spirit at daybreak or twilight between the cornstalks. The animal which is identified with the spirit is slaughtered, and its blood mixed with the seeds to promote their growth. The intoxicating properties of alcohol made of corn are attributed to the corn spirit. Alcoholic beverages were thought to contain evil spirits. Delirium tremens, which often follows its use, was believed to be due to the spirit. The modern term spirit for alcohol is a relic of an ancient and medieval superstition.

A plant used to counteract the effect of the spirit causing ophthalmia was peytle. It received its name from the idea that the plant when eaten fills the eyes with wonder. One or two hours after the plant is ingested, if the eyes are closed there is seen a series of kaleidoscopic visions.

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148. Arabs and ancient Germans believed that beneficial spirits inhabited plants. The idea was derived perhaps from the fancied resemblance of the roots to the human form.

Cactus plants were admired by many American Indians. They looked on them as incarnations of the gods of fire and light. The ancient Greeks attributed the nourishing qualities of cereals to the gods and goddesses who governed them. In Greek mythology the Olympian goddess Demeter governed the growth of vegetation.

The Latin Church has removed drugs from the realm of the gods and put them in the province of saints. Thus the pharmacopeia is supplied with drugs such as St. Bartholomew's fever liniment (a preparation of oil of turpentine, tincture of opium and camphor), St. Bartholomew's tea (Paraguay), St. Jacob's oil (a liniment containing aconite), St. Lucas' bark (Caribbean bark), St. Thomas' balsam of Tolu and St. Germain's tea, known as spices laxantis (a mixture of sena elder flowers, fennal anise and potassium bitartrate).

ANALYSIS AND CONCLUSION

An ultimate analysis of demonology in its relation to medicine leads to the conclusion that the purpose of the exorcist or sorcerer was to inspire confidence in the patient. His ritual, his made-up appearance, his solemn rites, uttered in a resonant tone, were intended to make the patient receptive to the suggestions of the magic formulas. This was the aim of the Neoplatonic ecstasy through which it was assured that the soul would flee from the earth to become a part of the external world. This was the goal of the Veda philosophers of India, who tried by exhilaration to accomplish a union of the individual ego with Brahma, and this was the purpose of the exorcist who hoped to infuse faith in the mind of the possessed. Faith and suggestion were and still are the underlying principles of all medical cults.

From the periods of ancient Egypt, Assyria, Greece and Rome to medieval Christianity down to modern mesmerism, hypnotism, Christian science, spiritualism and Couéism, an unreal conception of physical phenomena dominated the minds of people. To such a state of mind, faith forms the basis of successful practice. The Assyrian physician who attributed disease to spiritual forces realized the importance of winning the patient's confidence before he attempted to relieve the person of his ailment. He was aware that the patient's recovery was largely dependent on the impression he made on him.

The ancient world was credulous. It believed in the power of spells and charms. It had faith in the efficacy of noises and odors to drive away evil forces. It believed in the power of colors; certain colors of wool were symbolic of various phases of sickness. It had faith in the power of using a scapegoat. It was believed that the taboo of the sick could be transferred to an animal. Such ideas were bound to influence the mind of the patient, who would then yield easily to spiritual healing.

It is estimated that about 75 per cent of all medical diseases belong to the mental, or self-limited, type. The late Hobart Emory Hare, professor of therapeutics at the Jefferson Medical College, was in the habit of telling his students that patients may be divided into four classes. One class (which makes up the largest majority of patients) will recover, physician or no physician. Another class will die in spite of the physician. Still another class will die because of the physician, and the fourth class will recover when carefully treated by a trained physician.

The largest number of persons who seek medical aid belong to the group with functional neuroses, for whom drugs are of slight virtue and whatever little merit they might have is due to their suggestional effect. Patients with functional neuroses with their shifting pains, their illusions, hallucinations, insomnias, phobias, hysterical manifestations, depressions and exhilarations are the despair of the family physician. They do not respond to ordinary therapeutic remedies. Confidence, kind advice and thoughtful suggestions are preferred to skill and knowledge of medicine. A bone of a skeleton of a medieval saint may achieve more benefit to the mentally diseased person than the best sedatives and restoratives. Patients of these types invariably sing the praises of Christian scientists and spiritualists and are responsible for their existence.

The psychologic principle on which suggestion rests is known as dissociation: the concentration of the mind on certain matters to the exclusion of others. The therapeutic effect of suggestion depends largely on the faith the diseased person has in the healer. Whether the method employed is the mumbling of a magic formula or the method of suggestion of the Christian scientists, the effect on the patient is the same.

It is well known that every mental change is followed by physical changes. The sensation originates in the brain. It emerges as a thought, and that thought results in an act. The more powerful its centripetal action, the stronger is the centrifugal reaction. For example, one is suddenly frightened and his mind is shaken with frantic thoughts. These thoughts, emerging from the brain, cause a trembling of the limbs, pallid features, loss of appetite and weakness. If the patient's confidence is established in the healer, his trouble will subside as soon as the healer allays his fright by certain suggestions. Faith and suggestion are the two pillars on which occult medical practice is founded.[149] No beneficial results will follow when trust in

149. Before Jesus consented to cure the two blind men, he asked them: "Believe ye that I am able to do this?" When they replied "Yes," he touched their eyes saying, "According to your faith be it unto you" (Matthew [48]).

the healer and in his methods is lacking or when the receptive organs of the patient are not able to respond to stimuli of suggestion. It is useless to try to make an impression on the brain withered by paresis. It is of no avail to offer a suggestion to an idiot or to a young child whose receptive centers have not as yet developed.

Not only is the cure of mental manifestations dependent on faith and suggestions, but even diseases of a physical nature may often be benefited by psychic treatment. Emotions such as fear may produce gastrointestinal symptoms, such as diarrhea, dyspepsia, vomiting, jaundice and blurred vision. Such disorders are better treated by allaying the cause of the fear than by medicinal therapeutics. Tachycardia and high arterial pressure may be caused by fright and nervous irritation, for which circulatory or cardiac sedatives are less indicated than psychic treatment.

Persons whose parents were troubled with cataract frequently imagine that they have the disease. The fear of hydrophobia when a person is bitten by an animal will often produce symptoms of rabies without actual infection. Fear of pregnancy often stops the menstrual flow. Such patients cannot be treated medically or surgically. Indeed, almost every psychic action may produce a reaction and bring on a functional disorder in persons who have a delicate mental mechanism. The physician who attempts to treat nervous and mental conditions as physical maladies shows no more superior knowledge than the faith healer who attempts to treat pneumonia, cardiac disease, nephritis or diabetes by suggestions. When a patient troubled with so-called imaginary disease is told by his physician that he is not sick because he could not find any corroborating signs, the physician not only loses his patient but is responsible for the patient's joining healing cults. There is no such thing as imaginary disease. One who habitually feigns disease is troubled with some form of abnormality.

An interesting development is the disposition among psychiatrists to recognize powers in man beyond those of the usual and normal consciousness. The most able exponent of this theory was James. The theory forms the most important advance which psychology has made since the day of Fechner and Weber and explains the effect of suggestion on a subconscious mind.

During the World War Parsons [150] observed patients with blindness following shell shock who were free from any definite organic lesions either in the eye or in the visual paths. The condition was often associated with impairment of the other special senses. Parsons expressed the belief that the condition in such cases was due to hysterical

150. Parsons, J. H.: The Psychology of Traumatic Amblyopia Following the Explosion of Shells, Lancet 1:697, 1915.

predisposition aggravated by bodily fatigue, continuous excitement and the fear of death constantly before the eyes. The recovery in such cases is slow but complete and depends on how soon those fears are mitigated.

A number of years ago Park Lewis reported the case of a 10 year old girl who became suddenly blind.[151] She had a considerable amount of hyperopia in one eye. The other eye was amblyopic. When she put on her newly ordered glasses, she complained of blurred vision in either eye. Her father, hearing her remarks, exclaimed, "She is going blind." The father's suggestion promptly acted on the child. No lesion could be noticed in the eye, and the pupils readily reacted to light. The child's vision returned under simple suggestive treatment. Park Lewis in a series of 6 similar cases was successful in bringing back vision by psychic treatment in the form of suggestions.

I recall the case of a young woman who diagnosed her own condition as glaucoma. She seemed to have known the symptoms of the disease from her late mother, who suffered with congestive glaucoma. Her family physician, who treated her mother, prescribed miotics and sedatives for her, but aside from a subacute conjunctivitis the examination failed to show any of the cardinal symptoms of glaucoma. I realized that to make light of her trouble at the first call would have no affect on her, for she was convinced of her own diagnosis. I therefore did not contradict her. I suggested taking off the dark glasses and discontinuing the medicine until the next examination, remarking that even if it were glaucoma it was of a very light type and might not require any medication. In a few days the conjunctivitis cleared, and after several office calls, at which time her condition was discussed and home remedies were suggested, all symptoms disappeared.

With the appearance of the psychiatrist, psychic healing has been removed from the province of the charlatan and fanatic and placed in the care of the well learned and scientific physician who knows how to differentiate between mental and physical disorders, who confines his specialty to mental and psychic disorders and excludes all diseases and symptoms of organic or surgical nature. The psychiatrist differs from the various healers of the past and present not so much in the treatment of purely mental conditions but in the recognition of the symptoms and diseases, whether they are of a physical or a psychic nature.

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151. Lewis, F. P.: Psychic Disturbances Involving the Eye, Ann. Ophth. **23**: 217, 1914.

CITRIC AND MALIC ACIDS OF THE OCULAR TISSUES

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For a long time it has been known that citric and malic acids take part in the general organic acid metabolism of plants and animals. Recent investigations suggest that the oxidation of citric acid in muscle and many other tissues passes through the following consecutive stages: citric acid → isocitric acid → oxalosuccinic acid → alpha-ketoglutaric acid → succinic acid → fumaric acid → levomalic acid → oxaloacetic acid → citric acid. It appears that the citric acid cycle is one way by which carbohydrate is oxidized in muscle tissue. There is reason to believe that a similar metabolic process occurs in ocular tissue.

The interest in the past has been mainly centered on the amount of citric acid in the intraocular humors. In 1927 Ahlgren [1] found a citric acid dehydrogenase in lens. Two years later Grönvall, using the method of Thunberg, noted that citric acid is a normal constituent of the aqueous humor of the rabbit and pig. Nitzescu and Georgescu [2] in 1930 used the same method to study human and bovine aqueous humor. In 1937 Grönvall [3] published a thorough study on the citric acid content of the intraocular fluids. His results may be summarized by the following statements: Citric acid which was determined by the Thunberg method was found in the intraocular fluids of the mammals, birds and fish. The amount in birds was higher than that in other animals. Unlike dextrose, citric acid was evenly distributed throughout the vitreous humor. In fetal life the citrate content of the intraocular humors slowly declined until birth. After intravenous injection of citrate, the amount

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1. Ahlgren, G.: On the Oxidation Mechanism of the Crystalline Lens, Acta ophth. **5**:1, 1927.

2. Nitzescu, I. I., and Georgescu, I. D.: La teneur en acide citrique de quelques liquides animaux (liquide cephalorachidien, humeur aqueuse, liquide folliculaire, liquide amniotique), Compt. rend. Acad. d. sc. **190**:1325, 1930.

3. Grönvall, H.: Citric Acid Studies Referring to the Eye, Acta ophth., 1937, supp. 14, p. 1.

in the aqueous humor rose and fell with that of the blood serum. The cornea showed an irreciprocal permeability to citrate which was dependent on the integrity of the epithelium. The corneal endothelium retarded the diffusion of the salt less than did the epithelium. The retina contained citric acid dehydrogenase. In iridocyclitis, glaucoma and melanosarcoma of the choroid and after paracentesis of the anterior chamber the aqueous humor contained an abnormally large quantity of citric acid. There was no quantitative difference in the citric acid content of the aqueous humor of cataractous and aphakic eyes. If the eye was kept in the dark, the amount of acid in the aqueous and the vitreous humor diminished.

Although malic acid takes part in cellular respiration, it is scarcely mentioned in articles on ocular chemistry. Adams [4] and Ahlgren [5] noticed that the normal lens oxidized malic acid.

Because there is a definite need for inquiry in the organic acid metabolism of the eye, an investigation was made into the quantities of citric and of malic acid in the ocular tissues. This report gives the results of the analyses and a discussion of the state of these two acids in the ocular metabolism.

METHOD

The citric and malic acid contents of bovine ocular tissues were determined by the method of Pucher, Vickery and Wakeman.[6] The procedure of analysis as it was applied to ocular tissues is briefly described.

The ocular tissues of 200 eyes from cattle 3 to 4 years of age were dissected free. Cornea, lens and optic nerve were ground. Sclera was finely divided with scissors. Each sample of about 20 Gm. was weighed, mixed with several volumes of a 10 per cent solution of trichloroacetic acid and placed in the refrigerator at 5 C. for sixteen hours. After the mixture had been filtered, the residue was extracted three times by trituration with a solution of trichloroacetic acid. The combined extracts were concentrated on a steam bath to a thick gum. The gum was thoroughly mixed with .0.5 cc. of fourth-normal sulfuric acid, and asbestos was added. The mixture was transferred to an extraction thimble and extracted with dry ethyl ether for eight hours. The extract was shaken with a solution of sodium hydroxide to remove the organic acids to the aqueous phase, and the ether was removed by distillation. The organic acid solution was boiled for ten minutes with a few cubic centimeters of a 50 per cent solution of sulfuric acid to remove traces of ether. A small quantity of bromine

4. Adams, D. R.: Investigations on the Crystalline Lens, Proc. Roy. Soc., London, s.B **98**:244, 1925.

5. Ahlgren, G.: Gibt es einen Stoffwechsel in der Kristallinse? Skandinav. Arch. f. Physiol. **44**:196, 1923.

6. Pucher, G. W.; Vickery, H. B., and Wakeman, A. J.: Determination of Malic Acid in Plant Tissue: Simultaneous Determination of Citric and Malic Acids, Indust & Engin. Chem. (Analyt. Ed.) **6**:288, 1934.

water was added to the cooled solution to precipitate foreign substances. The solution was oxidized and brominated by means of potassium permanganate and potassium bromide. By this process the citric acid was converted to pentabromacetone, which was extracted from the mixture with purified petroleum benzine U. S. P. The solution of purified petroleum benzine was in turn extracted with a 4 per cent solution of sodium sulfide, and the resulting yellow extract was made up to a definite volume with pyridine. The amount of color was read on a Pulfrich spectrophotometer with filter S43.

The oxidation-bromination product of malic acid, which remained in the solution from which the pentabromacetone had been extracted, was steam-distilled into an acid solution of dinitrophenylhydrazine. The water-insoluble orange precipitate which was formed was dissolved in pyridine. An aliquot of this solution diluted with water and made alkaline with sodium hydroxide resulted in a blue solution. The extinction coefficient was determined, using filter S47, and the malic acid present was calculated.

COMMENT

The results of quantitative analysis of the ocular tissues for citric and for malic acid are given in the accompanying table. Although the time for preparation of a sufficiently large sample for analysis was necessarily long, there is reason to believe from preliminary tests that the quantities which were found were relatively within a normal range.

As may be expected, the amount of citric acid was low and constant except in the optic nerve, for which no explanation can be given. The ratio of citric acid to malic acid was about 1:10 in the ocular tissues. The tissues which have little metabolism have small amounts of acid. The acid in the vitreous humor probably arises from natural diffusion from the surrounding tissue and not from the metabolism of this tissue.

The basis for the belief that citric and malic acids take part in the metabolism of ocular tissues may be given in a brief account of the investigation of their behavior in mammalian tissues.

Many studies have been made to account for the origin of citric acid in animal tissue, fluid and excreta. Citric acid is distributed widely in common foods, but experiments have shown that feeding of the acid results in excretion of no more than 2 per cent of the amount ingested. Sherman, Mendel and Smith [7] found that on a diet low in citrate during prolonged alkalosis the amount of citric acid excreted is greatly in excess of the amount present in the food. Since Pucher, Sherman and Vickery [8] showed that there is little preformed citrate in kidney, muscle or blood, citric acid must be synthesized in the body.

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7. Sherman, C. C.; Mendel, L. B., and Smith, A. H.: The Citric Acid Formed in Animal Metabolism, J. Biol. Chem. **113**:247, 1936; The Metabolism of Orally Administered Citric Acid, ibid. **113**:265, 1936.

8. Pucher, G. W.; Sherman, C. C., and Vickery, H. B.: A Method to Determine Small Amounts of Citric Acid in Biological Material, J. Biol. Chem. **113**:235, 1936.

In the previous investigations, the substances to be tested were given orally. Orten and Smith [9] decided to eliminate the unknown factors of the degree of absorption and the action of bacteria in the intestinal tract. They administered intravenously four groups of materials to be tested. Their results are significant. Group 1, which included sodium chloride and sodium gluconate, exerted no appreciable change on the citric acid content of the urine. Group 2, consisting of sodium bicarbonate, sodium acetate, sodium glycolate, sodium glycinate-bicarbonate, sodium lactate, glycerol-sodium bicarbonate and dextrose-sodium bicarbonate, exerted an alkali effect; the citric acid was from 2 to 4 times the basal value. Group 3, which included sodium butyrate, sodium acetoacetate, sodium aspartate-bicarbonate and sodium levulinate, gave from 7 to 10 times the amount noted from the basal diet. Group 4,

Citric and Malic Acid Contents of Ocular Tissues

		Mg. per 100 Gm. Wet Weight					
		Citric Acid			Malic Acid		
Tissue	Number of Samples	Minimum	Maximum	Average	Minimum	Maximum	Average
Conjunctiva	1	...	...	1.0	....	....	6.5
Cornea							
Whole	4	1.1	1.5	1.3	8.8	14.9	11.3
Epithelium	6	2.8	4.5	3.3	24.5	34.8	28.4
Struma and endothelium	1	...	...	1.4	....	....	9.4
Sclera	3	1.1	1.5	1.3	6.9	8.1	7.3
Iris	2	1.3	1.7	1.5	10.4	13.3	11.9
Choroid with retinal pigment epithelium	3	2.4	4.3	3.2	18.5	29.0	23.1
Lens	8	1.8	2.4	2.2	9.9	13.5	11.4
Vitreous humor	3	0.9	1.2	1.1	7.7	8.1	7.9
Retina	5	1.0	1.6	1.3	12.9	13.9	13.3
Optic nerve	5	3.6	4.9	4.1	25.7	55.0	39.2

consisting of sodium malonate, sodium succinate, sodium fumarate, sodium malate and sodium maleate, gave values from 30 to 40 times greater in the case of the first four salts and 120 times greater when sodium maleate was injected. In 1938 Smith and Orten [10] reported that the intravenous injection into dogs of the sodium salts of malonic, succinic, fumaric and malic acids produced a definite increase in the excretion of citrate within thirty minutes. Within sixty minutes the rate of excretion reached a maximum, after which it decreased progressively to reach a normal level within four and one-half to six and one-half hours after injection. The formation of citric acid took place at the same rate in dogs that were given injections for the first time as in

9. Orten, J. M., and Smith, A. H.: A Study of Certain Metabolites and Related Compounds as Precursors of Endogenous Citric Acid, J. Biol. Chem. **117**:555, 1937.

10. Smith, A. H., and Orten, J. M.: The Rate of Citric Acid Formation Following the Injection of the Sodium Salts of Certain Dicarboxylic Acids. J. Biol. Chem. **124**:43. 1938.

those that were given injections previously. This suggests that the mechanism by which the citric acid is produced under these conditions is the same as that which exists in the normal animal.

The results obtained by Orten and Smith [9] seemed to indicate that the sodium salts of malonic, succinic, fumaric, malic and maleic acids or some products formed from them enter into the formation of citric acid in the body. They explained the alkali effect by suggesting that the substance causing it may be broken down in the organism to yield compounds similar to those derived from the five most potent substances. Succinic, fumaric and maleic acids may easily be converted into malic acid, which can unite with a two carbon compound, many of which are available in the body, to produce citric acid. There was also the possibility of an enzymatic catalysis either in the conversion of the injected compounds themselves into citric acid or in the inhibition of a hypothetic citrate-destroying system.

In the intermediate stages of oxidation of carbohydrate, citric acid catalytically promotes oxidation in muscle, especially in the presence of carbohydrate.[11] Szent-Györgyi and others [12] and Stare and Baumann [13] had previously shown that fumarate and its derivatives,

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11. Krebs, H. A., and Johnson, W. A.: The Role of Citric Acid in Intermediate Metabolism in Animal Tissues, Enzymologia **4**:148, 1937.

12. Gözsy, B., and Szent-Györgyi, A.: Ueber den Mechanismus der Hauptatmung des Traubenbrustmuskels: I. Mitteilung, Ztschr. f. physiol. Chem. **224**: 1, 1934. Ueber die Bedeutung der Fumarsäure für die tierische Gewebstatmung: II. Mitteilung: Szent-Györgyi, A.: Einleitung, Uebersicht, Methoden, ibid. **236**: 1, 1935. Banga, I.: Einfluss der C_4-Dicarbonsäuren auf die Gewebsatmung, ibid. **236**:20, 1935. Laki, K.: Oxydation and Reduktion der C_4-Dicarbonsäuren, ibid. **236**:31, 1935. Straub, F. B.: Mikrofumarsäurebestimmung und ihre Anwendung, ibid. **236**:42, 1935. Gözsy, B.: Mikrobernsteinsäurebestimmung und ihre Anwendung, ibid. **236**:54, 1935. Annau, E.: Vergleichende Versuche mit Fumarsäure und Malonsäure, ibid. **236**:58, 1935. Huszák, S.: Versuche in vivo, ibid. **236**:66, 1935. III. Mitteilung: Szent-Györgyi, A.: Einleitung, Uebersicht, Methoden, ibid. **244**:105, 1936. Straub, F. B.: Quantitative Methoden zur Untersuchung der Fumarsäurekatalyse, ibid. **244**:117, 1936. Bruckner, V.: Ueber die Reaktion der Oxalessigsäure mit Hydrazin und HNO_2, ibid. **244**:127, 1936. Banga, I.: Ueber Oxydation der FS. und Reduktion der OES. durch zerkleinertes Muskelgewebe, ibid. **244**:130, 1936. Blazsó, A.: Ueber die Reduktion der OES. im embryonalen Gewebe, ibid. **244**:138, 1936. Straub, F. B.: Decarboxylierung der OES. durch Muskelgewebe, ibid. **244**:140, 1936. Laki, K.: Ueber den H-Donator der OES.-Reduktion im Muskel, ibid. **244**:142, 1936. Annau, E.: Ueber die Fumarsäure-Katalyse und das Verhalten der Brenztraubensäure in der Leber, ibid. **244**:145, 1936. Laki, K.: Ueber die Funktion der Succinodehydrase, ibid. **244**:149, 1936. Banga, I., and Szent-Györgyi, A.: IV. Mitteilung, ibid. **245**:113, 1936. Laki, K.; Straub, F. B., and Szent-Györgyi, A.: Ueber die Atmungskatalyse durch C_4-Dicarbonsäuren, ibid. **247**:1, 1937.

13. Stare, F. J., and Baumann, C. A.: The Effect of Fumarate on Respiration, Proc. Roy. Soc., London, s.B **121**:338, 1936.

succinate, oxaloacetate and malate, increased respiration. It is probable then that citric acid is removed and later regenerated. To determine the intermediate substances, Krebs and Johnson [11] made studies of conditions under which citrate disappears. They found that citric acid in the presence of arsenite was oxidized to alpha-ketoglutaric acid. Malonate inhibited the oxidation of citric acid at the succinic acid stage. Martius and Knoop,[14] while working with citricodehydrogenase from liver, discovered that the oxidation of citric acid by methylthionine chloride (methylene blue) yields ketoglutaric acid.[12] If these and other investigations are correlated, the oxidation of citric acid in tissue may then be summarized as follows: citric acid → alpha-ketoglutaric acid → succinic acid → fumaric acid → levomalic acid → oxaloacetic acid.

If the oxidation of citric acid is a stage in its cyclic action, it must be resynthesized from the intermediates. Experiments by Krebs and Johnson [11] showed that pigeon breast muscle and the brain, testis, liver and kidney of rat can oxidize citric acid and synthesize it from oxaloacetic acid. By further experiments with living animals, Krebs, Salvin and Johnson [15] checked the results of Orten and Smith.[9] They found that the injection of fumaric oxaloacetic, levomalic and succinic acids resulted in the appearance of alpha-ketoglutaric and citric acids in the urine. It has been demonstrated that in the presence of oxaloacetic acid under anaerobic conditions, muscle tissue can form large amounts of citric acid. Under the same conditions it has not been possible to form citric acid from any other intermediate.

Investigations have been carried out to determine the source of the other two carbon atoms. Addition of various possible precursors, such as acetate or pyruvate, did not affect the rate of synthesis of citric acid. This fact, however, does not prove that acetate or pyruvate did not enter into the synthesis, because both are readily formed from oxaloacetic and are already present in the tissue if oxaloacetic acid was added. Since the catalytic effect of citrate on tissue respiration is more pronounced in the presence of alpha-glycerophosphate or a similar substance, Krebs and Johnson suggested that the substance supplying the two extra carbon atoms is a derivative of carbohydrate, provisionally termed "triose." This triose might well be pyruvic acid, for animal tissue is able to synthesize succinic acid if pyruvic acid is present. With the resynthesis of citric acid from oxaloacetic acid and "triose," the cycle is completed.

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14. Martius, C., and Knoop, F.: Der physiologische Abbau der Citronensäure, Ztschr. f. physiol. Chem. **246**:1, 1936. Martius, C.: Ueber den Abbau der Citronensäure, ibid. **247**:104, 1937.

15. Krebs, H. A.; Salvin, E., and Johnson, W. A.: The Formation of Citric and α-Ketoglutaric Acids in the Mammalian Body, Biochem. J. **32**:113, 1938.

Investigation on a few other intermediate compounds might be mentioned. It had been suggested by Wagner-Jauregg and Rauen [16] that isocitric acid is an intermediate in the oxidation of citric acid. Krebs and Johnson [11] showed that isocitric acid is easily oxidized in muscle at about the same rate as citric acid. On oxidation isocitric acid would yield oxalosuccinic acid, which is so unstable it is not known in the free state.[14] In acid solution it is easily decarboxylated to give alpha-ketoglutaric acid.[17]

Martius and Knoop [14] noted the possibility of considering cis-aconitic acid as an intermediate. They assumed that the conversion of cis-aconitic acid into citric acid is reversible and expressed the belief that it has a part in the breakdown of citric acid. Krebs and Johnson [11] are not certain whether the reaction is an intermediate step in the breakdown or in the synthesis of citric acid.

The other intermediate successive stages in the citric acid metabolism apparently are: oxaloacetic acid → citric acid → isocitric acid→ oxalosuccinic acid → alpha-ketoglutaric acid.

It is reasonable to believe that the citric acid and malic acid which occur in the ocular tissues behave metabolically in the same manner as these acids do in other mammalian tissues. The part malic acid plays in the carbohydrate metabolism of the lens has been discussed in a previous paper on the chemistry of the lens.[18]

SUMMARY

The amount of citric and of malic acid in the ocular tissues was determined. The ratio of citric acid to malic acid was 1 : 10 in each ocular tissue. The metabolism of these acids in relation to the eye is discussed.

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16. Wagner-Jauregg, T., and Rauen, H.: Die Dehydrierung der Citronensäure und der Iso-Citronensäure durch Gerkensamen-Dehydrase, Ztschr. f. physiol. Chem. **237**:227, 1935.

17. Blaise, E. E., and Gault, H.: Recherches sur les cetodiacides, Compt. rend. Acad. d. sc. **147**:198, 1908.

18. Krause, A. C.: Chemistry of the Lens: VIII. Lenticular Metabolism, Arch. Ophth. **17**:468 (March) 1937.

CHANGES IN ANGIOSCOTOMAS ASSOCIATED WITH THE ADMINISTRATION OF SULFANILAMIDE

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BROOKLYN

Widening of angioscotomas has been shown in cases of glaucoma, venous obstruction, retinal edema and raised intracranial pressure.[1] In these cases the widening was believed to be due to a filling of the perivascular spaces with a relative or absolute damming back of the fluid to the synapses of the first and second neurons of the retina.[2]

It has been shown by Evans and McFarland[3] that angioscotomas also widened when the person under study was subjected to oxygen deprivation. The recently reported effect of sulfanilamide on trachomatous pannus and the known relation of sulfanilamide to the oxygen-carrying substance of the blood and hemoglobin seemed to indicate that a study of the relation of sulfanilamide to angioscotomas might be fruitful. With this thought in mind it became necessary to review certain aspects of the knowledge of sulfanilamide.

Sulfanilamide, chemically, is an azo compound, paraaminobenzenesulfonamide. It is interesting to note that Hawking[4] in determining the pharmacologic properties of sulfanilamide found that a solution in a dilution of 1:1,000 had no action on the intestine of rabbits or the uterus of guinea pigs or on a frog's heart perfused through the inferior vena cava. He also found that 0.17 Gm. of sulfanilamide per kilogram of body weight given to a cat anesthetized with a barbiturate derivative had no effect on the blood pressure.

Marshall and his co-workers[5] found that the drug was absorbed from the intestinal tract within four hours and that it took from two to three days to establish an equilibrium between the amount ingested

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1. Evans, J. N.: An Introduction to Clinical Scotometry, New Haven, Conn., Yale University Press, 1938, pp. 80-90 and 112.

2. Evans,[1] pp. 131-149 and 151.

3. Evans and McFarland, cited by Evans,[1] p. 224.

4. Hawking, F.: Pharmacological Actions of Sulfanilamide, Lancet **2**:1019-1020 (Oct. 30) 1937.

5. Marshall, E. K., Jr.; Emerson, K., Jr., and Cutting, W. C.: Para-Aminobenzenesulfonamide; Absorption and Excretion: Method of Determination in Urine and Blood, J. A. M. A. **108**:953-957 (March 20) 1937.

and the amount excreted. After that had been established, they found that it took about the same length of time to free the body of this drug. This fact is borne out by the results obtained in the cases to be cited.

Sulfanilamide distributes itself throughout all the tissues of the body and body fluids, and it has been found that the concentration of this drug is slightly lower in the spinal fluid than it is in the blood.[6]

Marshall and Walzl [7] showed "that clinical cyanosis may be unaccompanied by any decrease in the oxygen carrying capacity of the blood." In their summary they stated: "An investigation of the oxygen capacity and total iron pigment of the blood of patients receiving sulfanilamide indicates that the cyanosis may not be due to non-functional iron pigment. In some instances small amounts of methemoglobin were found, but it is questionable if this is the principal cause of the cyanosis."

It thus becomes apparent that any changes which might occur in the angioscotomas of those persons to whom sulfanilamide had been administered could not be attributed to oxygen deprivation. With these basic facts in mind, the reported investigations were made.

TECHNIC AND MATERIAL

The technic for angioscotometry used in these experiments was that routinely employed at the Long Island College Hospital.

The Lloyd stereocampimeter with the light affixed to the instrument [8] was the one used in this experiment. The objects employed were the 0.60 and 0.54 mm. white silver spheres,[9] although at times the 0.28 mm. silver object was also necessary.

Two subjects were selected from patients in the hospital. They were free from any disease or anomaly as determined by ocular examination. They were in good physical health so far as their respiratory, cardiovascular, renal and central nervous systems were concerned,[10] as determined by the medical department. They were both intelligent seamen and cooperative.

After a complete ocular examination, in which the fundi were carefully studied and no pathologic changes were observed, the patient was allowed a half-hour rest period. A control (normal) map of the angioscotomas was then made. Care was taken to have the patient fully informed of the procedure and able to comprehend what was expected of him. The visual acuity, blood pressure and pupillary diameters were also determined. In view of the subsequent developments, it was significant that the answers of both subjects were quickly given and were accurate and dependable.

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6. Marshall, E. K., Jr.; Emerson, K., Jr., and Cutting, W. C.: Distribution of Sulfanilamide in the Organism, J. Pharmacol. & Exper. Therap. **61**:196-204 (Oct.) 1937.

7. Marshall, E. K., and Walzl, E. M.: On Cyanosis from Sulfanilamide, Bull. Johns Hopkins Hosp. **61**:140-144 (Aug.) 1937.

8. Evans,[1] p. 61.

9. Evans,[1] p. 49.

10. Later events proved that one of the subjects was epileptic.

After obtaining the preliminary maps, the patients were given 15 grains (0.97 gm.) of sulfanilamide by mouth every four hours. They were kept in bed, except during study and for bathroom privileges.

When the first subject had received a total of 135 grains (8.75 Gm.) of sulfanilamide after twenty-two hours, another map was made; the blood pressure, pupillary diameters, vision and fundi were studied. The same procedure was again carried out after the patient had received a total of 195 grains (12.64 Gm.) of sulfanilamide, which was thirteen and a half hours later. The administration of sulfanilamide was now stopped, and four days later the final control map made.

For the second subject, in addition to the procedure as outlined for the first patient, studies were made of the peripheral visual fields, and the quantity of sulfanilamide in the blood was determined. Another change made in the technic was that of the time for the mapping of the angioscotomas. Maps were made after eighteen hours, when a total of 90 grains (5.83 Gm.) of sulfanilamide was taken, and again after twenty-one hours, when a total of 180 grains (11.66 Gm.) of sulfanilamide had been administered. It was after this last dose that the administration of sulfanilamide was stopped. Forty-eight hours later the angioscotomas were mapped and the same ocular examinations performed. One hundred and twenty-four hours after this last dose of sulfanilamide, the final map was plotted.

The first patient, G. H., a white youth aged 19, a sailor, on examination was found to have a blood pressure of 124 systolic and 74 diastolic and a pulse rate of 90. The final diagnosis was that of epilepsy. Ocular examination gave entirely negative results. Vision was 6/5 in each eye. The subject had had one suggestive epileptic seizure eight days before these studies were made. No seizure occurred during the studies. One seizure occurred six days after they had been completed. It was assumed that the epilepsy bore no relation to the present study.

The second patient, S. C., a white man aged 28, a sailor, on examination was found to have a blood pressure of 110 systolic and 60 diastolic and a pulse rate of 74. The final diagnosis was periarthritis and possible beginning rheumatoid arthritis. Ocular examination gave entirely negative results. Vision was 6/5 in each eye.

ANALYSIS OF RESULTS

In order to analyze the results obtained, each case must be studied individually.

G. H. showed normal angioscotomas (chart 1 *A*). It should be noted that the configuration was classic and that the scotomas were of the usual width, being about 1 degree to 1½ degrees in width, 2 to 3 degrees from the blindspot of Mariotte. The mapping time was twelve minutes. There were no significant changes in the eyegrounds. After the patient had been receiving sulfanilamide for thirty-four hours, a total of 135 grains, the angioscotomas were remapped. A distinct change was noted (chart 1 *B*). There was a very marked narrowing of the angioscotomas. The shadows nearer the blindspots had been reduced to one third of the original size. Furthermore, it was impossible to follow the major angioscotomas out more than 7 degrees. Beyond this point it was impossible to elicit any scotomas. Effort, however, was made to study the original sites of the angioscotomas. Significantly, no changes were observed in the eyegrounds.

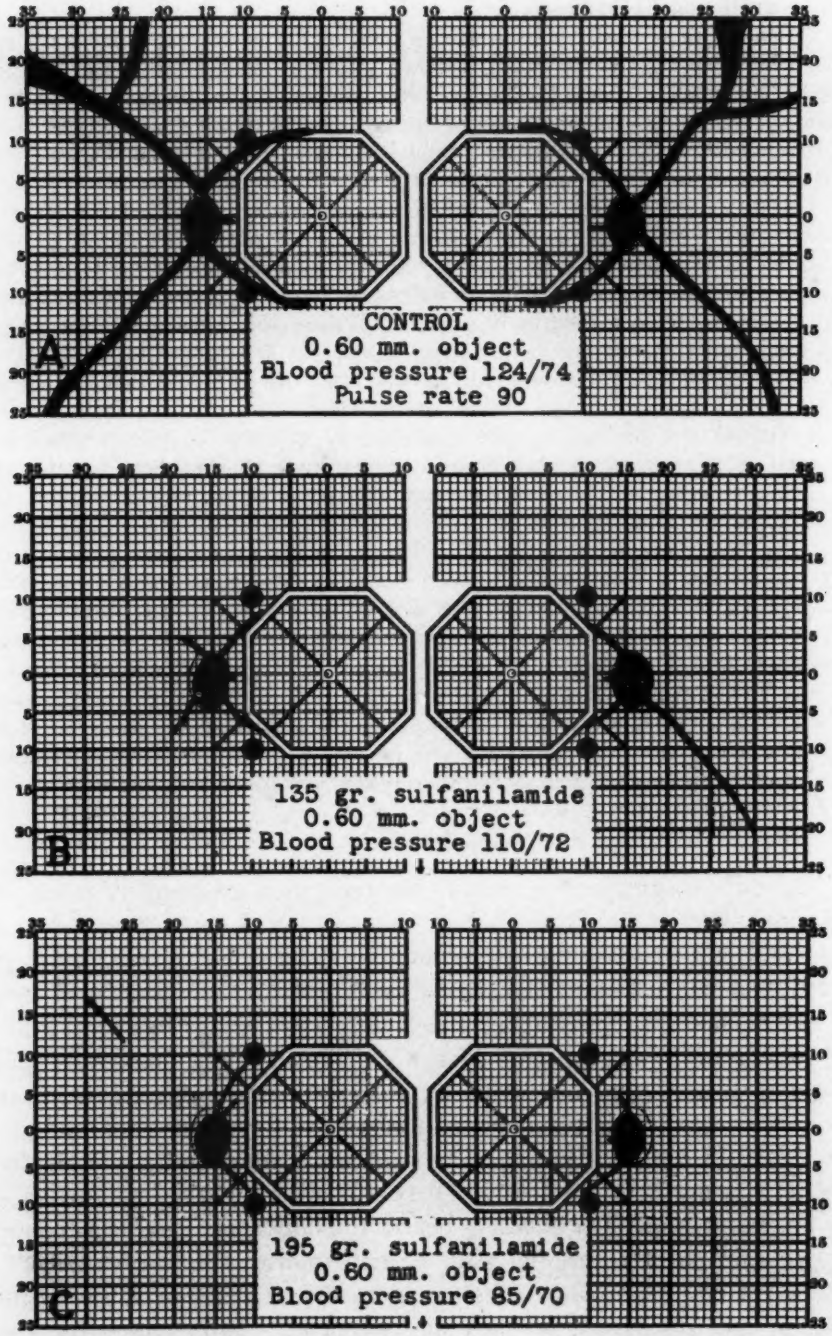

Chart 1.—First three charts for G. H., a youth aged 19, with vision of 6/5 in each eye. The studies were begun on Aug. 31, 1938.

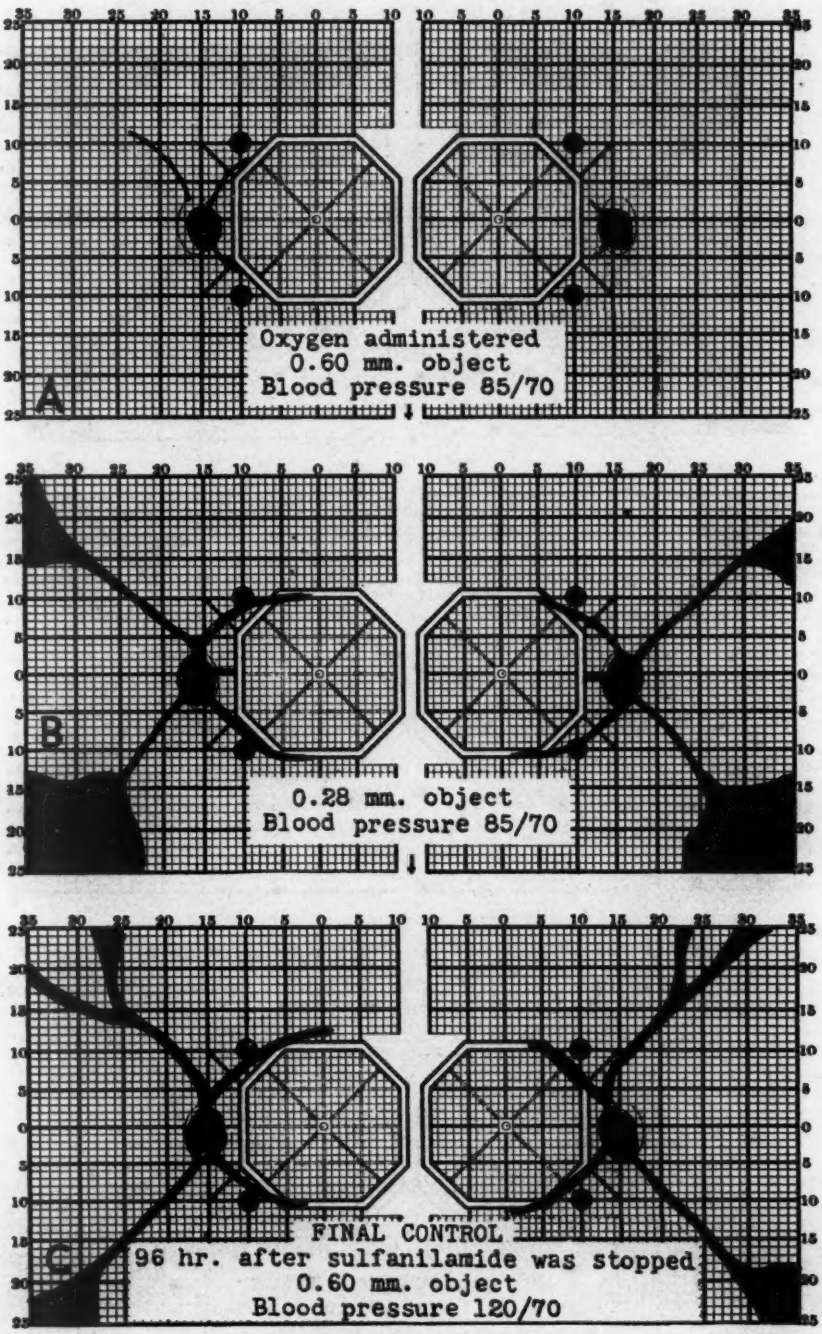

Chart 2.—Next three charts for G. H.

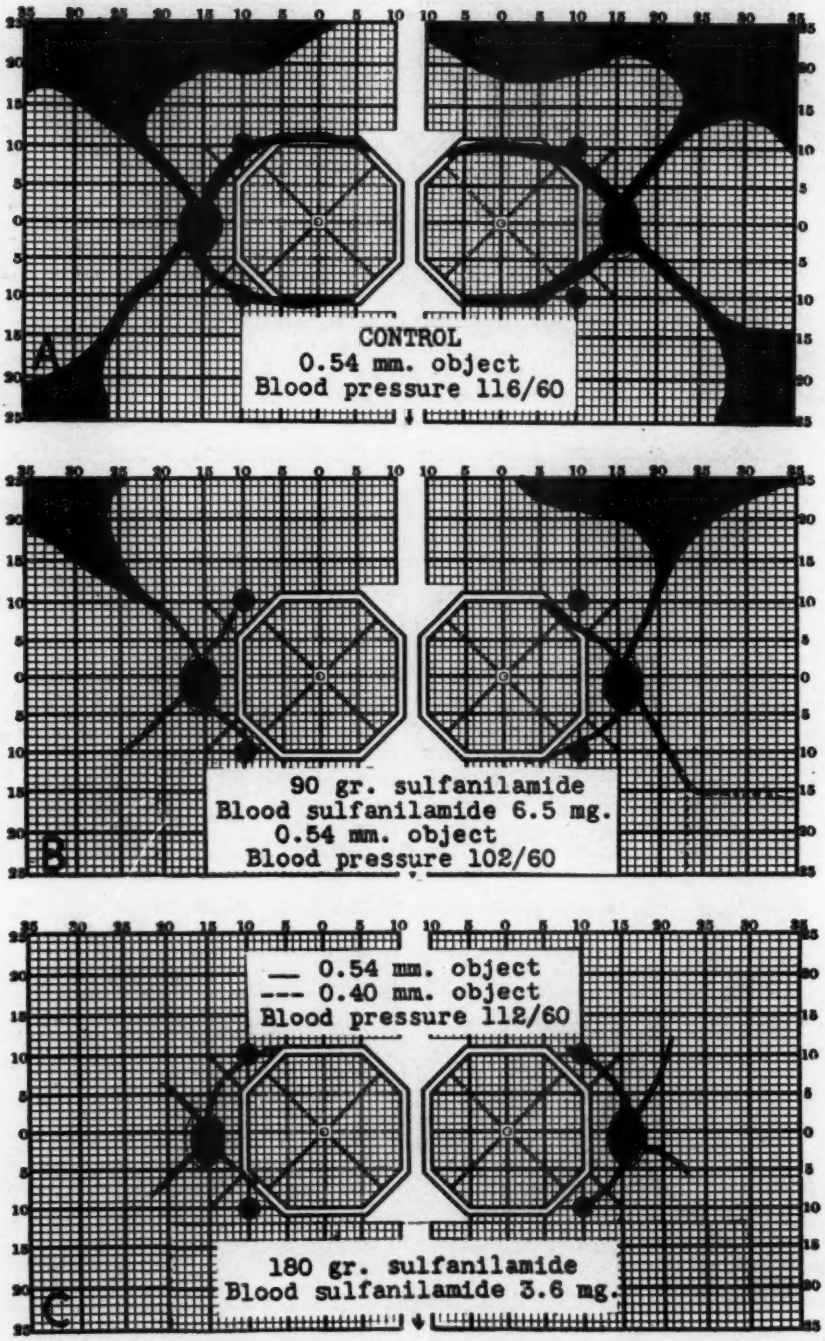

Chart 3.—First three charts for S. C., a man aged 28, with vision of 6/5 in each eye. The studies were begun on Sept. 19, 1938.

The map shown in chart 1 *C* was plotted when the patient had received a total of 195 grains of sulfanilamide, thirteen and one-half hours later. With the same test control, further changes were observed. Both blindspots were smaller. The angioscotomas were reduced in length and breadth. It was even impossible to map the temporal angioscotomas with the objects of the size indicated. The patient,

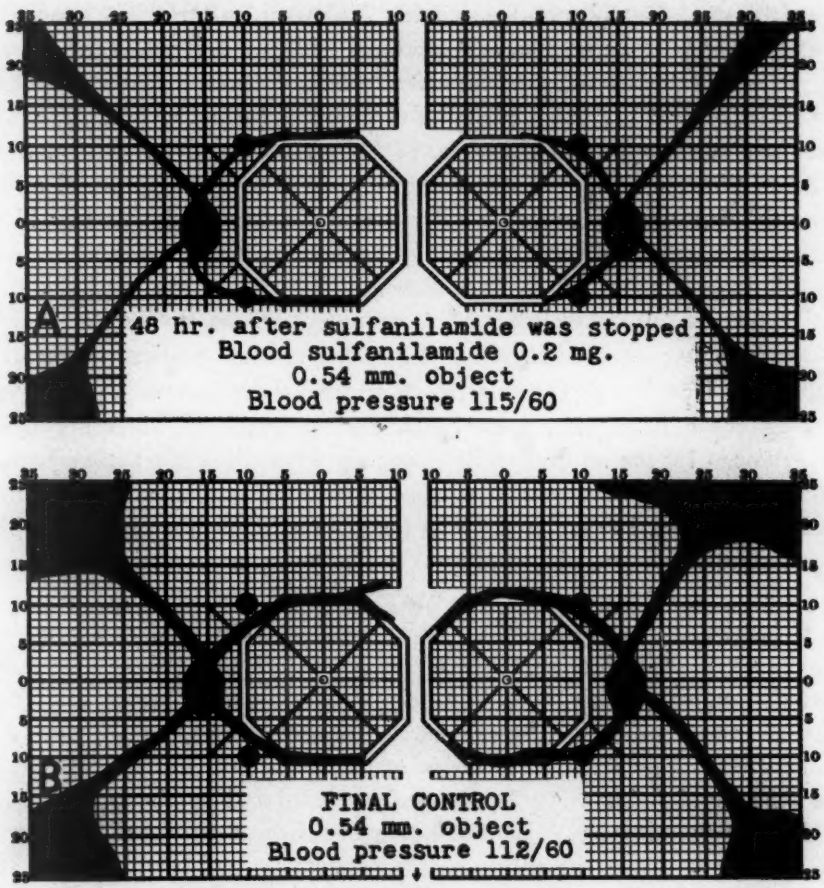

Chart 4.—Next two charts for S. C.

however, was alert. It was at this point that oxygen [11] was given by nasal catheter in an attempt to see what effect the inhalation would have on the narrowed angioscotomas. Study of the map in chart 2 *A* shows rather conclusively that no change occurred.

11. In some recent work, a report of which will be published later in the ARCHIVES, I have been able to show that the inhalation of oxygen was associated with a reduction in the width of the angioscotomas.

In an endeavor to show that the patient was capable of correct answers, the defect was remapped, a 0.28 mm. silver white object being used. Study of chart 2 *B* shows that the angioscotomas were almost normal in size with the use of this smaller object. Examination of the fundi at this time showed that the appearance remained unchanged from that originally noted.

The administration of sulfanilamide was stopped. Ninety-six hours later the final control map was made. This map (chart 2 *C*) shows the angioscotomas to be normal and identical with the original control.

It is interesting to note the effect that this drug had on the blood pressure of the subject. It steadily dropped from the control, which was 124 systolic and 74 diastolic, to 110 systolic and 72 diastolic, and later to 85 systolic and 70 diastolic; it then returned to normal at the time the final map was made. The reader is reminded that low blood pressure is ordinarily accompanied by a widening and not a narrowing of the angioscotomas.[12] No effect was noted on the size and shape of the pupils or on the vision, which remained 6/5 in each eye.

S. C., just as G. H., showed typical normal angioscotomas, the size being 1 degree to 1½ degrees in width (chart 3 *A*). His answers, just as those of G. H., were quick and accurate, no difficulty being experienced by the subject in determining when the object disappeared. The blood pressure was 116 systolic and 60 diastolic, and the pupils measured 4 mm. in diameter. The peripheral fields were normal. The fundi showed no pathologic process. The vessels were of average size and ratio. Vision was 6/5 in each eye, without correction.

After 90 grains of sulfanilamide had been administered by the method previously described, a map was made (chart 3 *B*). It should be noted that the angioscotomas were definitely narrowed, being about one third of their previous size. The patient at this time was mentally alert and cooperative. The results of ocular examination and the appearance of the peripheral fields were unchanged as compared to the observations at the first examination. The blood pressure showed only a slight drop in the systolic pressure, the values being 102 systolic and 60 diastolic. The sulfanilamide content of the blood was 6.5 mg. per hundred cubic centimeters of blood.

Twenty-one hours later, when a total of 180 grains of sulfanilamide had been administered to the subject, an even greater change was noted in the angioscotomas (chart 3 *C*). The narrowing was quite pronounced, and it was impossible to follow the scotomas more than 10 degrees out. With a somewhat smaller object, a 0.40 mm. silver sphere, it was possible to prolong the scotomas a greater distance. It is probable that if a 0.28 mm. silver white object had been used, the entire angioscotoma

12. Evans,[1] p. 80.

tree might have been mapped. The sulfanilamide content of the blood was 3.6 mg. per hundred cubic centimeters of blood.

The patient was somewhat nauseated, so the administration of sulfanilamide was stopped. The blood pressure was 112 systolic and 60 diastolic. Forty-eight hours after the cessation of the sulfanilamide, the map shown in chart 4 *A* was plotted. It will be noted that the angioscotomas are much wider than those in chart 3 *C*. In fact, they almost approach that of the initial control. It was not until one hundred and twenty-four hours after the foregoing map was made that the final control mapping was performed (chart (4 *B*). It will be seen at once that this conformed to the first control map in every detail. The fundi, vision, pupils and blood pressure showed no change. The only point to be borne in mind is that in this subject the blood pressure was constant throughout.

In both cases it is obvious that almost parallel results were obtained. It would seem justifiable, therefore, to draw the following conclusions, keeping in mind the conditions of this study:

1. During the administration of sulfanilamide there occurred a narrowing of the angioscotomas.

2. Four to five days after the withdrawal of the sulfanilamide, the angioscotomas had returned to normal.

COMMENT

It might be justifiable to assume that the changes noted were not due to oxygen deprivation, for, as shown by Evans and McFarland, angioscotomas widen under such conditions. Furthermore, there was no modification of the scotomas in the first case of this study when oxygen was administered.[13] One explanation, therefore, might be to postulate a relative increase in the oxygen present in the region of the retinal synapse.

One might, also, postulate a possible specific influence of sulfanilamide directly or indirectly on the synapse and retinal nutritive state.

Much more data must be collected before any theory can be devised. It is possible that study of the angioscotomas during the administration of various agents may lead to a better understanding of the action of drugs on the human organism.

13. Had facilities been available, oxygen deprivation would have been added during saturation with sulfanilamide.

EPISCLERAL GANGLION CELLS

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The ciliary ganglion was first described by Krause in 1852. While working to find out the function of this ganglion, Peschel [1] in 1893 ended with an exhaustive treatise on the orbital nervous system of the rabbit. In this work he discovered and minutely described eighty-five ganglion cells, forty-four of which were situated between the globe and the ciliary ganglion. He later also found many isolated ganglion cells in orbits of human beings. In 1907 Axenfeld [2] concluded that ganglion cells are frequently found in human beings, behind the sclera as well as in the scleral canal, and not rarely as many as thirty cells are grouped together, forming a small episcleral ganglion.

While working on a study of hypertensive neuroretinitis, such a ganglion was found and studied in serial section. It lay to the temporal side of the optic nerve just behind the sclera, was composed of five cells and was accompanied by a ciliary nerve (figs. 1 and 2). It showed no evident pathologic involvement. The episcleral ganglion was enclosed with the ciliary nerve in a connective tissue capsule through which it was adherent to the sclera and the optic nerve. The ganglion itself had a marked fibrillary stroma in which were deposited the ganglion cells (four). Surrounding the ganglion as a whole was an adherent capsule which was continuous with the epineurium of the outgoing fibers. The ganglion cells had a large cytoplasm filled with a definite nucleolus (figs. 3 and 4).

It is surprising to note the paucity of American literature on the existence of these cells in view of the fact that to the ophthalmologist it is interesting indeed. From a historical standpoint, Reichart [3] in 1875 was the first to describe ganglion cells in the ciliary nerve. He wrote:

> Associated with the ciliary nerves are here and there seen accumulations of ganglion cells in the neighborhood of the ciliary ganglion. With high power one sees them as round to oval cells with plainly defined round nuclei, dark nucleolus and granular protoplasm embedded in connective tissue rich in cells.

1. Peschel, M.: Arch. f. Ophth. **39**:1, 1893.
2. Axenfeld, T.: Ber. d. ophth. Gesellsch., Heidelberg **34**:300, 1907.
3. Reichart, M.: Beitrag zur Anatomie des Ganglion ophthalmicum, Munich, E. Stahl, 1875.

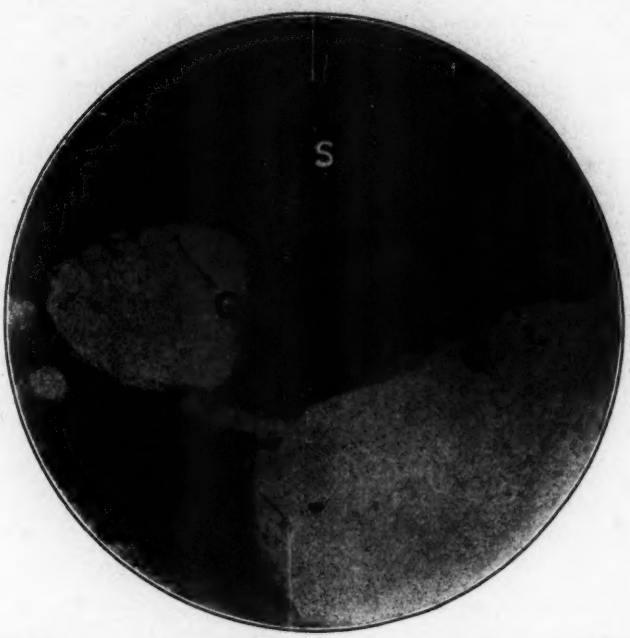

Fig. 1.—Low power magnification of a section of a ganglion showing enclosure of the ganglion (*G*) and ciliary nerve (*C*) in a connective tissue capsule and their relation to the sclera (*S*).

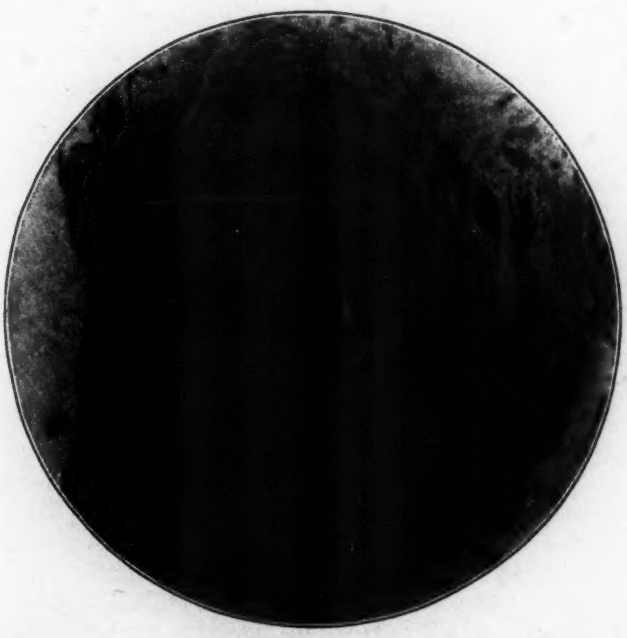

Fig. 2.—High power magnification of a section of the ganglion showing its normal structure (for comparison with fig. 5).

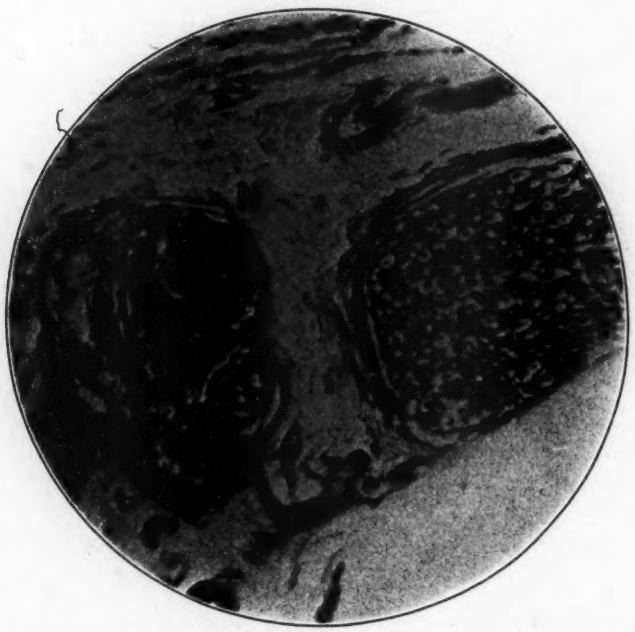

Fig. 3.—High power magnification of a section of the ganglion, trichrome stain being used to bring out the Nissl bodies (*N*).

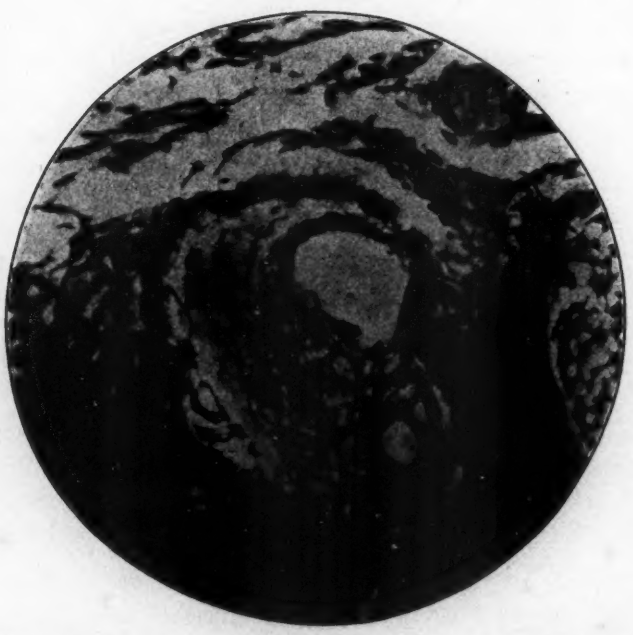

Fig. 4.—High power magnification of a section of the ganglion stained with Laidlaw's modification of the Bielschowsky stain to bring out the normal arrangement of the fibrillary structure (*F*).

From their form he felt that they were probably related to cells of the sympathetic type. The occasional return of sensation to the globe after an opticocilioneurotomy has been attributed to the outgrowth from these cells.

From a physiologic standpoint, the importance of the ganglion cells is brought out by the following investigations:

1. Sherrington had noted that on intracranial section of the sixth nerve degeneration of the nerve took place, but about twenty healthy fibers remained in the external rectus muscle. Coupled with this unexplained phenomenon was the knowledge that the third, fourth and sixth nerves contained sensory fibers the origin of which was doubtful. Duke-Elder seemed disinclined to attribute their origin to either the second or the fifth nerve or to the sympathetic nervous system. He seemed more satisfied to consider them as isolated ganglion cells of the sensory type, such as Helen Nicholson [4] described. The latter in 1924, in her study of a human fetus, isolated thirty ganglion cells of the sensory type in both the sixth and the third nerve.

2. Saitoh [5] extirpated the ciliary ganglion in order to study changes in intraocular pressure after this procedure. His results showed a lowering immediately after the operation, followed by a slight rise above the normal. Two days later the pressure was much lower but returned again to normal in two weeks. The instillation of epinephrine hydrochloride in the eye on which operation was performed caused a lowering of pressure as did the instillation of physostigmine salicylate. After the administration of pilocarpine, however, the pressure was elevated.

If these changes can occur, what are the possibilities of the isolated ganglion cells playing a part in the maintenance of ocular tension? Mawas [6] in 1936 found ganglion cells in the terminal fillets of the fifth and third nerves. He expressed the opinion that such cells take the place of the sympathetic type of cells to these parts. Ernyei [7] (1936) described a small sympathetic ganglion and bundles of nonmedullated nerve fibers in the neighborhood of the short ciliary nerves. He considered the latter a direct continuation of the sympathetic plexus of the internal carotid artery.

From a pathologic standpoint, Drs. Goldstein and Wexler [8] reported a case of Niemann-Pick disease in which lipoid degeneration was observed throughout the ganglion cells of the brain as well as in some accidentally found episcleral ganglion cells, as evidenced by a swelling of

4. Nicholson, H. J.: J. Comp. Neurol. **37**:31 (June 15) 1924.

5. Saitoh, S., abstracted, Zentralbl. f. d. ges. Ophth. **30**:76, 1933.

6. Mawas, J.: Bull. Soc. d'opht. de Paris, February 1936, p. 89.

7. Ernyei, S.: Arch. f. Ophth. **136**:40 (Sept.) 1936.

8. Goldstein, I., and Wexler, D.: Niemann-Pick's Disease with Cherry-Red Spots in the Macula: Ocular Pathology, Arch. Ophth. **5**:704 (May) 1931.

the cell, vacuolation of the cytoplasm and degeneration of the nucleus (fig. 5). That these ganglion cells may show changes in other diseases is not beyond the realms of possibility. Their presence should be kept in mind and serial sections made in an effort to locate such changes. A study of ganglion cell changes in primary glaucoma has to date disclosed no visible pathologic involvement in cases in which the glaucoma has advanced to the stage of marked excavation and atrophy.

Dr. Louise Meeker [9] noted in a nonbuphthalmic eye a plexiform neuroma of the choroid in which twenty-seven ganglion cells were present. Ganglion cells are commonly seen in the choroid but not normally

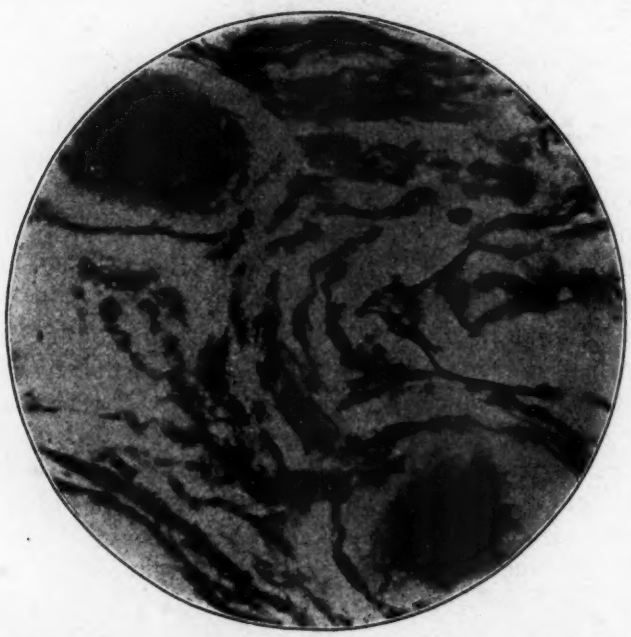

Fig. 5.—Ganglion cell obtained in a case of Niemann-Pick disease, showing swelling of the cell, vacuolation of the cytoplasm and degeneration of the nucleus.

in such a large number. In common with her observation was that of Freeman, who likewise reported ganglion cells in a neurofibroma of the choroid, embedded in "masses of fibrils." Knight [10] in a similar case reported the following observations:

> The choroid contains a rich plexus of both medullated and non-medullated nerve fibres which is derived from branches of the long and short ciliary nerves. Ganglion cells are found in groups at the nodal points of this plexus, and sometimes along the vessels. These fibres supply the choroidal vessels to their finest ramifications and are regarded as vasomotor in function.

9. Meeker, L.: Personal communication to the author.

10. Knight, M. S.: A Critical Survey of Neoplasms of the Choroid, Am. J. Ophth. **8**:791, 1925.

In Salzmann's [11] textbook it is stated that the "ciliary nerves frequently contain ganglion cells in the neighborhood of the sclera." From this one might not conclude that they are present as a rule. If one is to study ganglion changes in other diseases, one must first prove their constant presence. Accordingly, the following investigation was undertaken:

Ten eyes taken at random were studied, the choice being made of those eyes with the most sections available. Ganglion cells were found in every eye. They were situated usually with a ciliary nerve, more frequently on the temporal side but occasionally also nasal to the optic

Fig. 6.—Normal ganglion cell in the sclera (*S*).

nerve. They were found more often episclerally, but some were located along the optic nerve distant from the sclera and one cell was found in the sclera itself (fig. 6). One feels justified, therefore, to presume that the cells exist normally in every orbit, and the finding of these cells depends only on diligent searching.

SUMMARY

An accessory ciliary ganglion of Axenfeld found in a case of hypertensive neuroretinitis is described and is illustrated with photomicrographs. Such a finding is not very common.

11. Salzmann, M.: The Anatomy and Histology of the Human Eyeball in the Normal State: Its Development and Senescence, translated by E. V. L. Brown, Chicago, Chicago Medical Book Company, 1912.

In a study of 10 consecutive eyes ganglion cells were found in every eye situated usually with a ciliary nerve either sclerally, episclerally or a short distance removed from the globe near to the optic nerve.

CONCLUSION

Ganglion cells are probably present in every eye and therefore should be looked for. Changes noted should be classified as to type and pathologic conditions with which they are associated. A better understanding of their true function might in this way be concluded.

This investigation was done at the suggestion of the late Dr. Isadore Goldstein, of the pathology laboratory of the Mount Sinai Hospital.

TREATMENT OF SEVERE CORNEAL ULCER WITH SULFANILAMIDE

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A careful search of the domestic literature and the available foreign sources on the subject of sulfanilamide therapy has failed to reveal any reference to the use of this drug in the treatment of corneal ulcers. There is some reference to its employment for trachoma [1] and for gonorrheal ophthalmia.[2] Valuable information of a general character is obtainable in recent articles by Whitby [3] and by Lockwood and his co-workers.[4]

Sulfanilamide was first used as a specific agent against a certain strain of Streptococcus haemolyticus, but its range of activity has been rapidly and greatly widened, so that now it is advocated as a curative agent for a large variety of infections. And it seems that the clinician and the laboratory investigator are vying with each other to uncover additional virtues that may be resident in the drug, either in its original form or in its several derivatives.

Sulfanilamide is chemically paraaminobenzenesulfonamide. If the amino radical occupies any other than the para position, i. e., ortho or meta, the drug loses completely its therapeutic properties. In sulfapyridine (dagenan or M. & B. 693) pyridine replaces a hydrogen atom of the sulfonamide portion of sulfanilamide. It is claimed to be less toxic and more effective than sulfanilamide, to be adequate in smaller doses and to give rise to fewer side reactions. It is said to be potent against a greater variety of micro-organisms and against inoculums of greater virulence and concentration. Neoprontosil (disodium sulfamidophenyl-2′-azo-7′-acetylamino-1′-hydroxynaphthalene-3′,6′-disulfonate) is

1. Loe, F.: Sulfanilamide Treatment of Trachoma, J. A. M. A. **111**:1371 (Oct. 8) 1938.

2. Dees, J. E., and Colston, J. A. C.: The Use of Sulfanilamide in Gonococcic Infections: Preliminary Report, J. A. M. A. **108**:1855 (May 29) 1937.

3. Whitby, L.: Chemotherapy of Bacterial Infections, Lancet **2**:1095 (Nov. 12) 1938.

4. Lockwood, J. S.; Coburn, A. F., and Stokinger, H. E.: Mechanism of the Action of Sulfanilamide, J. A. M. A. **111**:2259 (Dec. 17) 1938.

another modification of sulfanilamide that is popular with some physicians. We have had such uniform success with sulfanilamide as such that for the present, at least, we prefer it to any of the several derivatives, with which we have had no experience and the advantages of which are still to be evaluated. Sulfapyridine is highly insoluble; hence it cannot be given subcutaneously when administration by mouth is not feasible, e. g., when there is persistent vomiting or a condition requiring absolute rest of the stomach.

Sulfanilamide is quickly absorbed and quickly eliminated, almost exclusively by way of the kidneys; therefore its use should be avoided in cases of renal disease lest severe toxic symptoms supervene or additional damage be done the kidneys. With grave infections a constant level of sulfanilamide in the blood of 10 to 15 mg. per hundred cubic centimeters is desirable. This is accomplished by giving in twenty-four hours at proper intervals 100 mg. per kilogram of weight. A person weighing 70 Kg. would receive a daily dose of 7 Gm., 2 Gm. as the first dose and the remaining 5 Gm. divided into equal amounts and given at intervals of four hours day and night. In less severe infections a blood concentration of 5 to 10 mg. is required. This is achieved by giving the patient 1 Gm. every four hours. The dose in each instance is gradually reduced. It has been determined that a constant level is best maintained by administration every four hours, since such spacing brings about an equilibrium between absorption and excretion of the drug. In ocular conditions, in which the infections are rarely of great virulence, we proceed as follows: Assuming that the patient weighs 70 Kg., he receives the first twenty-four hours 1 Gm. of sulfanilamide every four hours; the second day, 5 Gm. divided into six equal amounts and administered at four hour periods; the third day, 5 Gm.; the fourth, 4 Gm., and the rest of the week, 3 Gm. per day. It is infrequent that the drug has to be given beyond one week, in which event it may be continued in the smaller doses. A fixed schedule need not be adhered to; it may be varied according to circumstances. The dose should be somewhat increased or decreased in proportion to the weight. Children receive a greater quantity of the drug than their weight or age calls for (usually 50 per cent or more). Should serious toxic symptoms arise, administration of the drug should be stopped immediately; the symptoms will then disappear, as a rule, quickly. Relief from symptoms can be accelerated by the ingestion of copious draughts of water, which dilutes the drug in the blood and at the same time stimulates diuresis, which hurries its elimination. On the other hand, a patient treated with sulfanilamide should not drink more than the usual amount of water; otherwise the optimum concentration in the blood will not be maintained.

The toxic manifestations may be mild or severe or even grave, although infrequent. To the first category belong anorexia, nausea.

vomiting, abdominal cramps, precordial pain, headache, dizziness, lassitude, general weakness, moderate cyanosis characterized by a bluish pallor about the lips and cutaneous rashes. These symptoms do not demand interruption of the medication; the dose may be reduced if necessary. The serious toxic symptoms, which require immediate withdrawal of the drug and the institution of appropriate remedial measures, are: fever, the temperature sometimes rising as high as 105 F.; hemolytic jaundice and hemolytic anemia, best combated by frequent transfusions of a small amount of blood, and severe dermatoses, leukopenia and agranulocytosis. The patient should avoid exposure to sunlight, as sulfanilamide renders the skin photosensitive. Sodium bicarbonate may be prescribed together with the sulfanilamide to forestall acidosis, which sometimes accompanies sulfanilamide therapy. If cyanosis, which is probably due to oxyhemoglobin being changed into methemoglobin, is pronounced, it can be overcome by the administration of methylthionine chloride U. S. P. (methylene blue), 0.10 mg. every four hours. Sulfanilamide should not be used when there is renal damage with or without renal insufficiency, nor probably in cases of hepatic dysfunction. It is obviously contraindicated when there is an idiosyncrasy to the drug. Sulfanilamide may be given in conjunction with any other medicine whenever necessary. In our experience atropine sulfate or other sulfates, given locally or systemically, did not give rise to any untoward by-effects. Some physicians advise against the simultaneous use of saline cathartics.

Sulfanilamide is highly diffusible and very penetrating. It is rapidly disseminated throughout the body, appearing in all the tissues and fluids, both normal and pathologic, which is doubtless one of the reasons for the high therapeutic coefficient. Sulfanilamide is quickly absorbed and quickly excreted.

Its mode of action is not yet settled. As at present employed, it is not bactericidal; i. e., it does not directly kill the offending microorganisms, although it is antibacterial. It is not an antitoxin, nor does it possess immunologic qualities. It does not stimulate the reticuloendothelial system. It does appreciably increase phagocytic activity. It is, however, definitely bacteriostatic in that it hinders or arrests the multiplication of bacteria and brings about their death by rendering inimical the medium in which they grow, probably by interfering with the utilization of their pabulum. The action of sulfanilamide in vitro cannot be translated, without reservation, to the living human being. The bacteria inoculated in the human body do not necessarily behave in the same manner as they do on artificial mediums. A large dose also increases its sphere of influence; i. e., a greater variety of bacteria will succumb. We believe that in ocular therapeutics the range of usage of

the drug will widen as experience is gained with this agent in the treatment of diseases that are rebellious to the usually employed remedies. Sulfanilamide and its derivatives have been found curative in so many diseases caused by many different kinds of bacteria and viruses that they cannot be considered specific for any one type or group. Sulfanilamide is a drug of wide therapeutic range and is invaluable in a great number of unrelated infections, irrespective, to a great extent, of the character or individuality of the etiologic factor. We have found it also effective for lesions that are definitely nonbacterial in origin; witness the striking results with ulcers of the cornea caused by lime burns and trauma, as illustrated in the subsequent case reports. For ocular conditions, as already stated, smaller doses are sufficient, thus minimizing the hazard of toxic manifestations.

Sulfanilamide is of great value in the treatment of corneal ulcer. It is not recommended as a routine procedure. It is reserved for those ulcers which do not respond to ordinary measures. It is more effective and more convenient (since the eye receives no attention, except care at the office) than the more or less elaborate agents advocated in cases of severe ulcer, e. g., ultraviolet irradiation, which requires a special apparatus and extreme caution lest integral tissue be damaged. The electric cautery may spread its effect beyond the field of application, increasing the size of the final opacity or even perforating the cornea if the ulcer is deep. The thermophore demands a steady eye on the part of the patient to prevent the terminal from slipping over onto healthy tissue. Cauterization with various chemicals is often disappointing and may aggravate the pain after the effects of the anesthetic wear off. Paracentesis of the anterior chamber or incision of the ulcer means hospitalization and hardly appeals as an early method of procedure. Protein therapy by the intravenous route gives rise to fever and great discomfort. It is an ordeal, and the injections have to be repeated several times, to which the patient greatly objects. Protein injected subcutaneously or intramuscularly has been only moderately successful in our experience. It is for these refractory ulcers that sulfanilamide has produced such gratifying results.

The following striking features characterized all the cases of ulcer in which we administered treatment: Long before the ulcers were healed the patients were relieved of their pain, even while the ulcers were in a florid state. One is tempted, under the circumstances, to ascribe analgesic properties to the drug, for, with the delicate and exquisitely sensitive corneal fibrils still freely exposed the patients averred that they were comfortable, that the ocular pain and headache were gone and that they were able to sleep throughout the night, whereas previously the pain was agonizing and sleep without an opiate was impossible. The fact that sulfanilamide and many of the recent local

anesthetics are built up around the same chemical base, namely, aminobenzene,[5] lends support to the suggestion of sulfanilamide being an analgesic. At this point, attention may be directed to the thought that instillation of anesthetics over any considerable period of time is likely to impede the healing of the ulcer by depressing the local defensive mechanism, for all these anesthetics are protoplasmic poisons and thus retard the reparative processes. As a rule, when improvement sets in it proceeds uninterruptedly; the administration of sulfanilamide need not be persisted in until all objective evidences of the lesions have disappeared. Rarely is it necessary to resume the administration of the drug. It seems that once the condition is under control protracted intervention with the drug is no longer required, the first course of adequate treatment sufficing. Prior to receiving sulfanilamide, the patients were given local anesthetics at short intervals, each application being effective about fifteen minutes. Narcotics gave only temporary relief and had to be repeated frequently. The objective improvement was satisfactory and progressive, although restitutio ad integrum was not so rapid or so spectacular. The patients were ambulatory; the only one confined to the house had ulcer complicated by fever.

This paper is presented essentially as a clinical study. It is unavoidably lacking in certain laboratory data, which, however, does not interfere to any great extent with the practical application of the drug. The data referred to are those obtained by the daily calculation of the level of the drug in the blood, examination for methemoglobin, determination of the hemoglobin, the red and white cell counts and the cytologic features and identification of the causative micro-organism whenever possible. For ocular conditions, per se, the drug may be given with greater margin of safety than for serious systemic infections in which the patients' vitality is greatly impaired.

REPORT OF CASES

A number of cases of ulcer in which we administered sulfanilamide are briefly reported.

CASE 1.—J. S., a plasterer aged 36, with a weight of about 75 Kg., while plastering a ceiling on Nov. 1, 1938, was injured by some plaster falling into his right eye. He was referred to a competent ophthalmologist, who gave him routine treatment. A burn of the cornea and excruciating pain were present. Progress was unsatisfactory to both the patient and the physician, as the pain continued and the corneal lesion was increasing. Hospitalization was advised, but the advice was rejected. At this point the patient consulted us. Examination showed the lids of the right eye to be swollen and red and shut tight. The patient obviously was in great pain. Separation of the lids revealed the following condition: There was marked photo-

5. Rogers, E. B.: Sensitization Reaction to Sulfanilamide, J. A. M. A. **111**: 2290 (Dec. 17) 1938.

phobia; the eyeball was injected, and there was a large superficial circular ulcer of the cornea near the lower limbus. In the pupillary area of the cornea were two dense spots of ulceration and infiltration. Although atropine had been liberally instilled, the pupil was only moderately dilated. The patient was in such distress that a detailed examination had to be deferred. He was told to continue with the local anesthetic and opiate that had been prescribed by his previous medical attendant. We prescribed sulfanilamide, 2 Gm. as the initial dose followed by 1 Gm. every four hours day and night. On the patient's return to the office the next day, he stated that the pain in the eye was gone and that he had slept the whole night. One gram of sulfanilamide was now given every four hours, i. e., 6 Gm. per day; atropine was instilled, an ointment containing mercury bichloride applied and the eye covered. The next day the dose was reduced to 5 Gm. per day, which was divided into equal amounts and administered every four hours. The patient no longer required local anesthetics or opiates. On the fourth day he received 4 Gm. and on the fifth day 3 Gm. This dose was continued to the end of the week, when the administration of sulfanilamide was stopped, as there was no further need of the drug. Objectively, the progress was not pari passu with the relief of pain. The final result was a small superficial opacity below and extrapupillary and a narrow leash of blood vessels extending from the limbus toward the site of the opacity. Vision with correction was 20/20. During the course of treatment the patient complained of weakness, dizziness, anorexia and some nausea; there was a slight bluish pallor about the lips.

Case 2.—H. S., a driver aged 32, with a weight of about 65 Kg., on Nov. 29, 1938, had hot lead spattered into the left eye. He consulted us on December 3. There were several corneal ulcers at the corneoscleral junction medially and two small ulcers between the pupillary margin and the nasal limbus. Atropine was instilled, an ointment containing mercury bichloride applied and the eye covered. The ulcers did not yield to this treatment. By December 23 the ulcers had become confluent; ulceration was more extensive, now involving more than half of the cornea. The infiltration was deeper, and the pain was intense. The patient was given sulfanilamide in accordance with the foregoing schedule. Improvement was rapid; the pain disappeared quickly, and the ulcers healed excellently but rather slowly, leaving a thin opacification. The corrected vision was 20/40. There were only mild by-effects—weakness, anorexia and dizziness.

Case 3.—J. S., a housewife aged 24, consulted us on Dec. 8, 1938, giving a history of having scratched the left cornea eight weeks previously. During the interval she was treated by an ophthalmologist until the endurance of both the patient and the physician was exhausted. Examination revealed an infected ulcer in the pupillary area of the left cornea, deeply situated, with infiltration of the adjoining parts; the pupil was irregularly dilated, there were iritic pigment deposits on the anterior lens capsule, and several posterior synechiae were present. The patient had high myopia. She was immediately given sulfanilamide, as in the preceding cases. There was early relief of pain. On the second day of treatment a diffuse, discrete maculopapular rash appeared on her chest, and she complained of slight weakness, dizziness and anorexia. Treatment was persevered in, as these by-effects were mild. The rash left the chest, but a few days later large wheals appeared over the lower extremities, and there was pronounced edema of the ankles. The dose of sulfanilamide was reduced by 1 Gm. per day, and the eruption and edema disappeared. At the time of writing there was a rather deep scarring at the site of the corneal ulcer, which did not stain with fluorescein. Vision with a -4.25 sph. $\bigcirc$ -3.50 cyl., axis 180 equaled 20/40—.

CASE 4.—W. B., a man aged 63, consulted us on Nov. 30, 1938, giving the following history: He was operated on for peritonsillar abscess two months previously; four weeks later an ischiorectal abscess was incised and drained. For the past six weeks the left eye had been red and painful, with lacrimation. Examination at the office showed marked chemosis of the bulbar conjunctiva; the lids were red and swollen. The whole cornea was denuded of epithelium, and at the upper limbus there was rather dense infiltration. Fluorescein stained the entire surface diffusely, with deeper penetration in the upper part; the pain was intense. Atropine was instilled, and sulfanilamide was prescribed, 1 Gm. every four hours day and night. The following day there was decided relief of pain. Sulfanilamide was continued in gradually diminished doses. On December 3, the fourth day of treatment, the patient had an attack of syncope. The administration of sulfanilamide was stopped but was resumed the next day. Convalescence thereafter was uneventful. There remained a small superficial opacity in the upper part of the cornea. The visual acuity was unimpaired. The by-effects of the drug were anorexia, weakness, dizziness and an attack of syncope.

CASE 5.—I. R., a milliner aged 32, on April 29, 1938, scratched the right eye with a straw. She was treated by a colleague for ulcer of the cornea, with no improvement. She consulted us on May 9. She was in severe pain; the lids were swollen, and the eyeball was injected. In the upper part of the cornea were two small ulcers surrounded by infiltrated areas; below were two deep ulcers and hypopyon. The patient was given routine treatment until May 23. The pain continued as before. Sulfanilamide was prescribed. The pain subsided quickly, and the ulcers and hypopyon pursued a satisfactory course. On the patient's discharge there was evidence of a rather broad circumferential but extrapupillary opacity. The corrected vision was 20/30. The by-effects were anorexia, weakness, dizziness and slight cyanosis.

Three additional cases are instructive and deserve brief mention.

CASE 6.—W. L., a man aged 65, was practically blind in the left eye as the result of an old iridocyclitis which had been quiescent for years. There had been attacks of acute iridocyclitis in the right eye which responded to the usual measures. At no time could the etiologic factor be ascertained. The last attack occurred on Oct. 10, 1938. The eye was red and painful; there were vertical folds in Descemet's membrane and posterior synechiae. The pupil dilated irregularly with atropine. The usual medication was prescribed, but the condition became progressively worse. Many areas of punctate keratitis appeared, and the patient was in great pain. Sulfanilamide was ordered, 1 Gm. every four hours day and night. The following day there was marked improvement. The dose was reduced to 5 Gm. per day, and then to 4 Gm. On the sixth day of treatment the patient had a temperature of 103 F. He was told to stop the sulfanilamide. The fever lasted three days. He visited our offices a few days later, at which time the pupil was round and well dilated; there was no punctate keratitis, Descemet's membrane no longer wrinkled, the fundus could be clearly seen, and the vision had regained its former acuity.

CASES 7 and 8.—Two patients were admitted to the Cumberland Hospital with traumatic perforation of the cornea, prolapse of the iris and lenticular débris in the anterior chamber. The prolapsed iris of each patient was excised secundum artem; the anterior chamber was irrigated to remove the free lens substance and a conjunctival flap was brought over the corneal wound. Three days later the

anterior chamber was filled with pus, and it seemed that it would be necessary to resort to enucleation or evisceration. The patients were given sulfanilamide. The suppuration was arrested; the purulent exudate became organized, and the eyeball was saved. The vision, as was to be expected, was practically extinguished.

CONCLUSIONS

We wish to state the reasons why we prefer to administer sulfanilamide by mouth. It is obvious that it is much simpler and less disagreeable than when given subcutaneously or subconjunctivally. The latter methods of approach require the daily frequent presence of a nurse or a physician, as the case may be, a situation that predicates hospitalization. What is more important is the necessity of maintaining a constant level of the drug in the blood. It has been established that when the drug is ingested at intervals of four hours, the ratio between absorption and elimination is such that this is achieved. It is apparent that different criteria must be used in the case of subcutaneous or subconjunctival injections, for in these instances the drug is more readily absorbed and doubtless more rapidly excreted.

SUMMARY

Sulfanilamide was administered in 9 cases of severe involvement of the eye with strikingly favorable results; 6 of these were cases of severe corneal ulcer, the ulcer in most instances being due to chemical burns and trauma. The subjective improvement was rapid and spectacular. The final visual acuity was extremely good. The lesions themselves healed less rapidly; however, progress was more satisfactory than with the usual measures employed for these conditions. Medication was exclusively by mouth. All of the patients exhibited side effects, which, however, did not interfere appreciably with the pursuit of the treatment.

LIPIN KERATITIS OF HURLER'S SYNDROME (GARGOYLISM OR DYSOSTOSIS MULTIPLEX)

CLINICAL AND PATHOLOGIC REPORT

MILTON L. BERLINER, M.D.
NEW YORK

In 19 of the 20 cases of Hurler's syndrome reported in the literature bilateral corneal cloudiness has been observed. Recently, 2 children, brother and sister, aged 5 years and 7 months, respectively, were referred for examination to the ophthalmologic clinic of the New York Hospital by the staff of Dr. S. Z. Levine of the department of pediatrics. A third patient, a boy of 6 years of age, was seen in Dr. Bernard Samuels' service at the New York Eye and Ear Infirmary. The eyes of all 3 children were examined with the slit lamp. The first patient (R. M., fig. 1) died after an operation performed to repair an umbilical hernia, and autopsy was performed. This case will be reported in full by the department of pediatrics of New York Hospital. At autopsy I was fortunate in obtaining one of the eyes from this child for histologic examination.

Gertrude Hurler [1] in 1919 recognized that the features in her 2 cases, namely, dwarfism, deformity of the limbs, enlargement of the liver and spleen and corneal opacity, represented a new syndrome. Ellis, Sheldon and Capon [2] reported 7 additional cases and because of the large head and grotesque inhuman facies suggested the name of gargoylism. Ashley, Stewart and Watkins [3] recently reported a case with autopsy observations and suggested that the name of this syndrome should rightly be known as Hurler's syndrome.

The general histologic picture is one of infiltration of a lipid-like substance in the tissues, but chiefly in the liver, spleen, lymph nodes, anterior lobe of the pituitary gland and cornea. For this reason the syndrome has been classified as a fifth member in the category of lipidoses. The other four include amaurotic family idiocy (Tay-Sachs) and the Niemann-Pick, Hans-Schüller-Christian and Gaucher syndromes. The differentiating factor in these diseases apparently depends not only on the

Read before the New York Academy of Medicine, Section of Ophthalmology, Jan. 16, 1939.

1. Hurler, G.: Ztschr. f. Kinderh. **24**:220, 1919.

2. Ellis, R. W. B.; Sheldon, W., and Capon, N. B.: Quart. J. Med. **29**:119, 1936.

3. Ashby, W. R.; Stewart, R. M., and Watkins, J. H.: Brain **60**:149, 1937.

organs in which the lipoid storage occurs but on the chemical nature of the lipin itself. In both amaurotic family idiocy and the Niemann-Pick syndrome the deposit of lipin is found in the form of a phosphatide. In amaurotic family idiocy the site of predilection is in the nervous system, muscle and glial cells. With the Hans-Schüller-Christian syndrome the whole body may be involved, the chemical deposit being cholesterol or its esters, which is seen in the large foam cells. In

Fig. 1 (case 1).—Side view of R. M., aged 5 years, showing a large head with prominent frontal protuberance, a large abdomen and umbilical hernia and thickened wrists, hands and feet.

Gaucher's disease, which affects chiefly the viscera (liver and spleen), kerasin is found. These various lipins have physical as well as chemical differences. In Hurler's syndrome the deposits of lipid appear in the form of fine, curved, rod-shaped granules, and their exact chemical nature is unknown. It is believed to be a complex compound of lipin and protein. It is interesting to note that the eye may be affected in all of these so-called lipid syndromes. However, in Hurler's syndrome

the cornea is the site of predilection for the infiltration of lipid; the other ocular structures remain uninvolved.

There are many salient clinical features in Hurler's syndrome. Enlargement of the cranium with prominence of the frontal bones is almost constant. The bridge of the nose is depressed. There is marked shortening of the cervical portion of the spine, so that the large head seems to sit directly on the shoulders. The clavicles are wide. Kyphosis is usually present. Roentgenograms frequently show a widening of the sella turcica, but no bony erosion has been noted. The long bones are shorter and thicker than normal. There is marked limitation of movement of the arms and legs. The hands are short, clumsy and clawlike. The teeth are widely spaced and irregular. The tongue is large and protruding. Invariably there is enlargement of the liver and spleen. The musculature is poorly developed, and frequently there is abdominal distention with umbilical hernia. Sexual development remains infantile. Some of these persons may reach adult life, but progressive mental retardation generally results in imbecility. In all instances the parents were found to be normal.

Kressler and Aegerter [4] reported a case with autopsy observations and stated:

> The eye was fixed whole and sectioned longitudinally. The choroid, retina, iris and lens appeared healthy. The anterior and posterior epithelial layers of the cornea were normal, but the laminae of the cornea proper were widely separated. Whether this was an artefact secondary to fixation or the result of edema or infiltration, is a matter of conjecture. The possibility of infiltration with the same material that invades the other tissues should be considered. There was no cellular infiltration or other pathology to explain the corneal opacity during life.

A study of the illustration of the corneal preparation which was shown in their article undoubtedly shows that the large areas of separation of the corneal lamellae were entirely due to artefact.

Ashley, Stewart and Watkins stated that the cornea, at first cloudy, acquires an opaque milkiness which reduces vision markedly. They noted that the corneas were larger than normal and that the pupillary reflexes were normal. Extensive pathologic reports were given for 2 cases; in 1 the patient was aged 19 and in the other aged 3 years. However, no histologic examination of the corneas were done.

OCULAR APPEARANCE OF AUTHOR'S PATIENTS

Slit lamp examination of the corneas of all 3 of my patients revealed a typical form of infiltration. All showed the characteristic milky haze with diffuse illumination.

In the youngest child, aged 7 months (a sister of the boy who died), the earliest signs of this peculiar cloudiness were seen occupying the central areas of both corneas. The peripheral areas were only slightly infiltrated and permitted

4. Kressler, R. J., and Aegerter, E. E.: J. Pediat. **12**:579, 1938.

deeper examination of the eyes. The iris, lens, vitreous and fundus of each eye were normal. The tension was 12 mm. (Schiötz). The corneas were slightly larger than normal. The anterior chambers were fairly deep. In the optical section, just

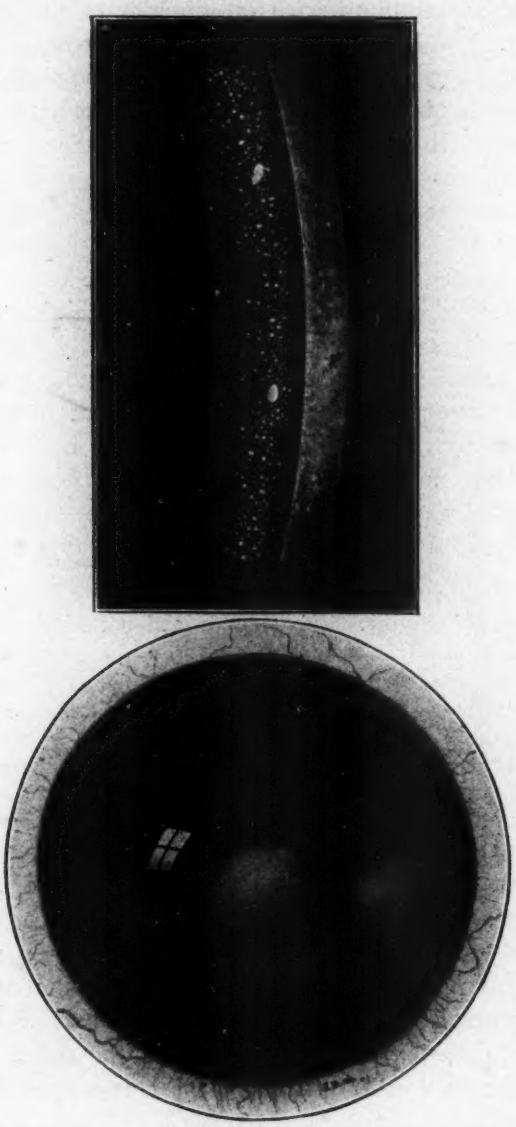


Fig. 2 (R. M.).—Upper illustration, slit lamp appearance of right cornea in optical section with yellowish white deposits in the middle and deeper corneal layers. Lower illustration, milky haziness of the right cornea seen in diffuse illumination.

below the corneal epithelium, a few fine changes were observed. The infiltration began in the anterior middle layers and increased in density to the posterior corneal surface. The infiltration was seen as a collection of small punctate dots, varying in size. The deeper deposits had a yellowish hue. This may partly be

due to the iris reflex. There were no vessels. The posterior corneal surface showed a few pigment deposits.

The corneas of the child's brother (R. M.), the first patient, on whom postmortem examination was later performed, showed an identical infiltration, only more extensive, the entire corneal area being involved (fig. 2). His corneas showed the same milkiness but were more opaque than those of his sister. No vessels were seen. His vision was approximately 10/200 in each eye. The fundi were poorly visualized but were deemed normal. The corneas were larger than was normal for a child of his age. The anterior chambers were deep. The tension was 14 mm. (Schiötz) in each eye. There was no nystagmus.

The third patient (D. R.), aged 6 years (fig. 3), also showed the general characteristic signs of this syndrome. His right cornea had the diffuse corneal

Fig. 3.—D. R., aged 6 years, showing typical facies found in Hurler's syndrome and the denser corneal opacity of the left eye.

haze with the typical punctate infiltration. However, the fundus in this eye was well visualized and was normal. With a —8.00 diopter lens the vision was 20/200. In the left eye the infiltrate was denser in the central areas of the cornea, which was ectatic and thinned. The vision in this eye was reduced to perception of hand movements. The intraocular tension was normal (fig. 4).

The first patient (R. M.) died after an operation performed to repair an umbilical hernia. Clinically and at postmortem examination he had all the features found in this syndrome. This case will be reported in full in the near future by Dr. J. Washington, of the department of pediatrics of the New York Hospital. The right eyeball of this patient was obtained at autopsy and was studied histologically.

PATHOLOGIC REPORT

Pyroxylin sections of the eye were prepared with various stains, including hematoxylin and eosin, Weigert's stain, Masson's stain and a silver stain. Gelatin

mounts of cornea were stained for neutral fat and were found to be negative. The deeper and central areas of the cornea corresponding to the infiltrated areas seen in life reacted paler to all the stains. Under low power magnification this area appeared as a lighter band. Under high power magnification, Bowman's

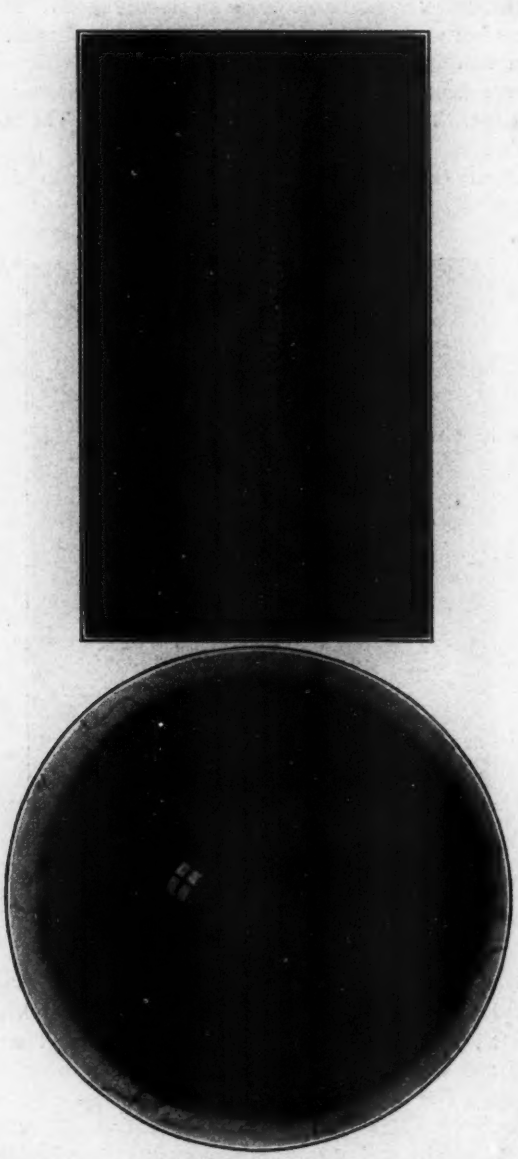


Fig. 4 (D. R.).—Upper illustration, optical section of the left cornea, showing typical punctuate deposits in the deeper layers. Lower illustration, milky haziness of the right cornea seen in diffuse illumination.

membrane was missing in places and was replaced by cells with vacuolated protoplasm, the cells varying from spindle shape to globular shape. The corneal nuclei lay in spindle-shaped vacuolated spaces. In the deeper central regions these

vacuolated spaces contained granular staining material. The presence of these lipid granules refutes any possibility that these spaces are the results of artefacts. The granules were well brought out with Masson's stain and with hematoxylin

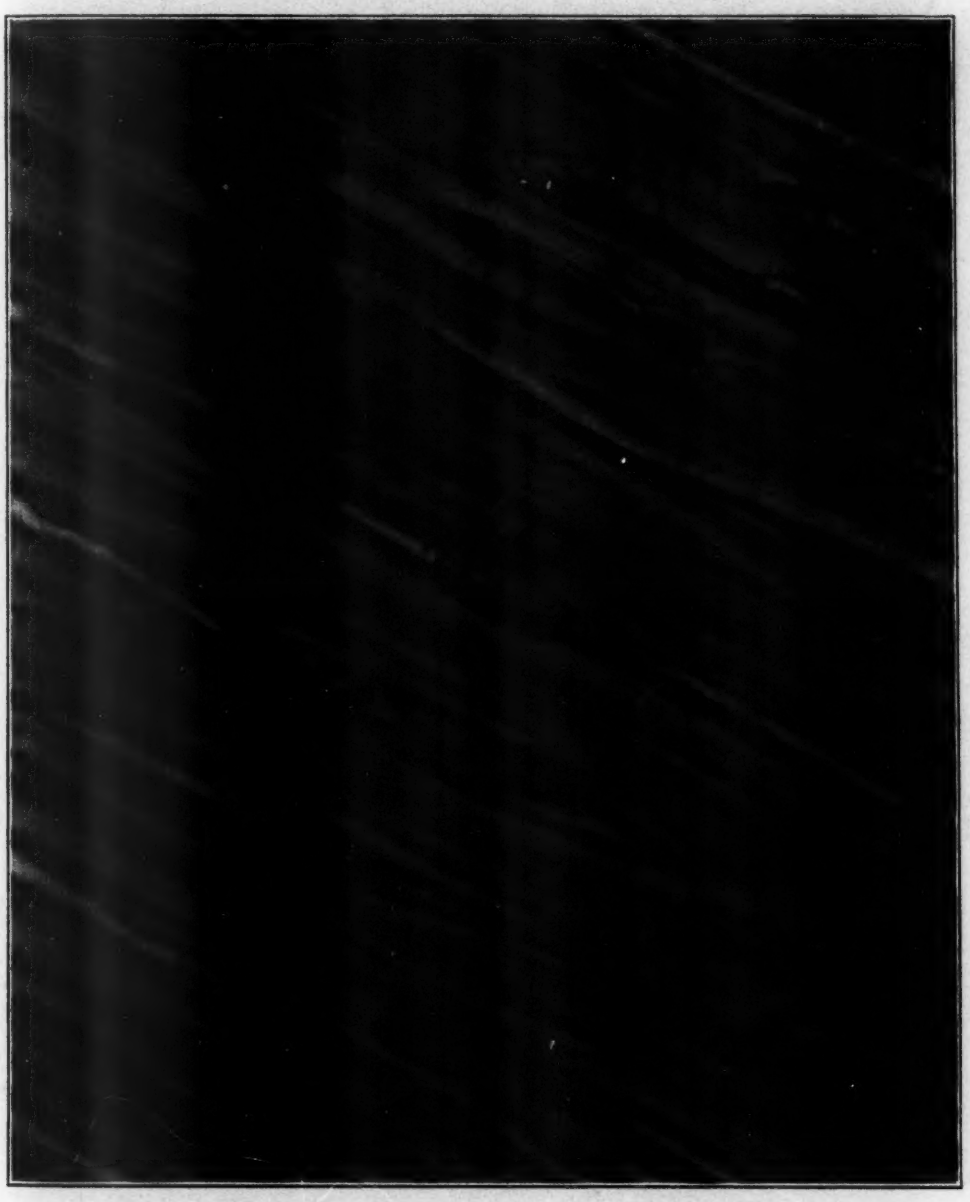


Fig. 5 (R. M.).—Corneal section (high power); hematoxylin and eosin stain. Pink-staining lipid granular material was seen in the dilated spindle-shaped interlamellar spaces.

and eosin and were similar in appearance to those found in other organs. There were a few pigment granules on the posterior corneal surface, some of which were

seen in the endothelial cells. There were no vessels. The angle of the anterior chamber was normal. There were no infiltrates in the uveal tract. The retina and optic nerve were normal (figs. 5 and 6).

Fig. 6 (R. M.).—Corneal section (high power); Masson's stain. Spindle-shaped spaces containing nuclei and granular lipid material are shown.

CONCLUSION

As far as I know this is the first slit lamp examination and informative histologic study made of the cornea in a case of Hurler's syndrome.

The corneal involvement is characteristic and of great diagnostic importance. It has been found in all cases reported, except 1 in which no mention of the eyes were made. With oblique illumination the corneal opacity is seen as a diffuse cloudiness. When viewed with the slit lamp in optical section, the opacity is seen to be composed of a fine yellow-white granular deposit in the deeper corneal layers. Histologically, the lipid deposits are found lying in spindle-shaped interlamellar spaces.

For purposes of differential diagnosis in all cases of dwarfism, cretinism and skeletal defects, the corneas should be inspected for the presence of this lipid infiltration, for I believe that there are many instances of this syndrome which have not been diagnosed.

PAGET'S DISEASE WITH ANGIOID STREAKS OF THE RETINA

REPORT OF TWO CASES

ROBERT K. LAMBERT, M.D.
NEW YORK

During recent years a large number of articles have been published on the subject of angioid streaks of the retina and their nature. While angioid streaks are most frequently associated with pseudoxanthoma elasticum, there have been a number of instances reported in connection with other conditions, as shown in the accompanying table. For example, 9 cases have been mentioned in connection with Paget's disease in the past; these were enumerated by Terry.[1] I was fortunate in

Cases Reported Since 1934

No. of Cases	Author	Associated Conditions
1	Jacoby, M. W.: Arch. Ophth. **11**: 828 (May) 1934	Trauma and active pulmonary lesion
2	Sugg, E. S., and Stetson, D. D.: J. A. M. A. **102**: 1369 (April 28) 1934	Diabetes mellitus
1	Klein, B.: Am. J. Ophth. **17**: 353 (April) 1934	Pseudoxanthoma elasticum
1	Hilding, A.: Am. J. Ophth. **18**: 369 (April) 1935	Pseudoxanthoma elasticum
3	Finnerud, C., and Nomland, R.: Arch. Dermat. & Syph. **35**: 658 (April) 1937	Pseudoxanthoma elasticum
1	Benedict, W. L.: J. A. M. A. **109**: 473 (Aug. 14) 1937	Absolute glaucoma (familial history of hypertension)
1	Goar, E. L.: Am. J. Ophth. **21**: 907 (Aug.) 1938	Traumatic rupture of choroid
2	Law, F. W.: Tr. Ophth. Soc. U. Kingdom (pt. 1) **58**: 191, 1938	None

encountering 2 more classic examples of angioid streaks in patients with this disease, and I thought them of sufficient interest to report. I believe that by directing attention to other conditions in addition to pseudoxanthoma elasticum in which careful investigation should be made for the presence of angioid streaks, more pathologic material may be obtained.

REPORT OF CASES

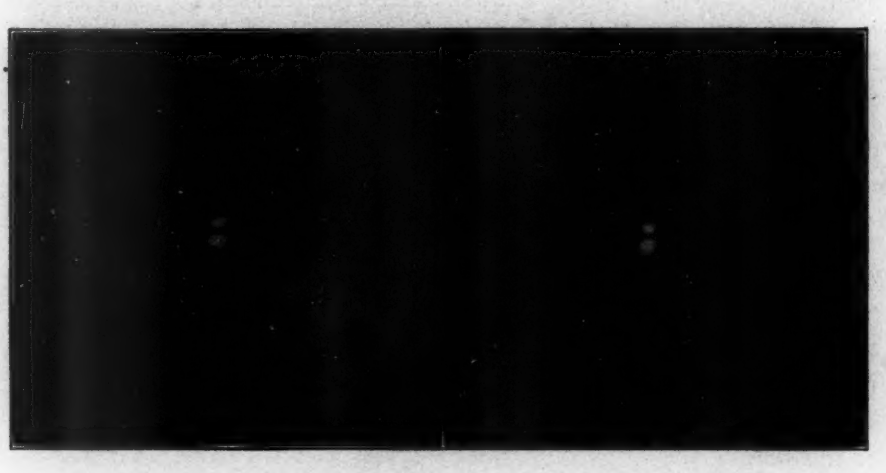
CASE 1.—M. G., a woman aged 52, was first seen in January 1938. She complained of spots before her eyes, loss of vision and of hearing, backache and general fatigue. She had previously been examined by Dr. Alice R. Bernheim, of the

1. Terry, T. L.: Angioid Streaks with Osteitis Deformans, Tr. Am. Ophth. Soc. **32**:555, 1934.

New York Hospital, and was found to have advanced Paget's disease. Roentgen examination of the skull and long bones showed characteristic changes, with a cystic area in the fibula somewhat suggestive of osteitis fibrosa. The calcium and phosphorus content of the blood were normal, and the phosphatase content was typical of Paget's disease.

During January the patient had a mass removed from her tongue at St. Luke's Hospital, which was diagnosed histologically as an epithelioma. The family history is of considerable interest. The patient stated that she was one of seven children and that she had two brothers who definitely were afflicted with Paget's disease. Both died of carcinoma, one of carcinoma of the jaw and the other of carcinoma of the esophagus. The patient has two sons, one of whom has bilateral microcornea, while the other is normal.

The ocular findings were as follows: Vision in the right eye was 10/200 without correction and 15/20 with a —2.50 sphere. Vision in the left eye was 15/200 without correction and 15/100 with a —3.00 sphere. External examina-



A, left nasal fundus of patient M. G.; *B*, right nasal fundus.

tion gave negative results. The muscle balance was normal. The peripheral fields were normal. The blindspots were slightly enlarged, and there was a small relative central scotoma in the left eye. The media of the right eye were clear save for a few floating opacities in the vitreous. Examination of the right fundus showed the nerve head to be sharp in outline, slightly pale and surrounded by an irregular halo of choroidal depigmentation. Stretching from the nerve head, there were five main typical pigmented streaks which radiated outward toward the nasal periphery. Between several of these streaks there were connecting small streaks. The streaks were fairly broad and irregularly pigmented. In the macular area there were several white spots. The fundus of the left eye was similar to that of the right eye save that there was less depigmentation about the nerve head and more pallor. The streaks presented the same appearance. The retinal vessels were of good caliber, and there were no hemorrhages present.

CASE 2.—H. G., a woman aged 65, was first seen in 1933 and has been examined from time to time since then. Her chief ocular complaints were blurred vision and one attack of transitory diplopia.

The patient was discovered to have Paget's disease about fifteen years before I saw her, when roentgenograms were made after a fall. The disease had progressed since then, and the hearing and vision had become continuously worse. There were advanced arteriosclerosis and moderate hypertension, the pressure varying between 160 and 180 systolic. Recently, there had occurred a minor cerebral accident affecting the patient's gait.

The ocular findings were as follows: Vision in the right eye was 15/70 without correction and 15/70 with a + 1.50 sphere ⊃ + 0.75 cylinder, axis 75 ⊃ 1 prism diopter, base in. Vision in the left eye was 15/70 without correction and 15/70 with a + 1.50 sphere ⊃ + 0.50 cylinder, axis 90 ⊃ 1 prism diopter, base in. External ocular examination gave negative results. Muscle balance was normal save for marked convergence weakness. The peripheral fields were normal except for a small sector in the upper inner quadrant of both eyes. The central fields could not be taken due to poor cooperation. Examination of the fundus of the right eye showed the nerve head to be of good color and to have sharp margins and a small temporal conus. The retinal arteries were slightly thinned but not excessively so. There were pigmented angioid streaks paralleling the course of the retinal vessels seen most vividly along the upper branches. The fundus of the left eye was similar to that of the right eye save that there was a pigment spot just between the nerve head and the macula. Below the nerve head, about 1 disk diopter away, there was a superficial retinal hemorrhage.

COMMENT

Clinically, certain facts are suggestive, and a number of theories and relations have been established, all of which bear confirmation. The association of angioid streaks with pseudoxanthoma elasticum, for example, points toward some fundamental disturbance of elastic tissue (Benedict and Montgomery [2]). The histologic picture of pseudoxanthoma elasticum consists of degenerative changes in the deeper layers of the skin.

Attempts to find some common factor between Paget's disease and pseudoxanthoma elasticum have been unsuccessful; in fact, osteitis deformans is not associated with any other known constitutional disease, unless it is cancer. In Paget's disease continuous resorption and deposition of bone take place. The resorption is due in large part to osteoclastic activity and is accomplished in a more or less irregular fashion. The new bone laid down in these resorbed areas is attached to the old structures by a wide and deeply staining cement substance. This phenomenon imparts to the bone a mosaic appearance, supposedly characteristic of the disease. The entire picture is one of attempt on the part of the skeleton to replace and compensate for the loss of the original bone. However, the replacement and compensation are inadequate.

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2. Benedict, W. L., and Montgomery, H.: Pseudoxanthoma Elasticum and Angioid Streaks, Am. J. Ophth. **18**:205 (March) 1935.

Numerous observers have linked angioid streaks with changes of a hemorrhagic or vascular nature (Plange, Knapp and others),[3] some of them even going so far as to localize the process in the posterior ciliary vessels (Clay[4] and Collins[5]). The familial tendency of angioid streaks has been pointed out by Law,[6] Wassenaar[7] and Holloway.[8]

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3. Cited by Lewis, G. M., and Clayton, M. B.: Pseudoxanthoma Elasticum and Angioid Streaks: Disease Syndrome with Comments on the Literature and Report of a Case, Arch. Dermat. & Syph. **28**:546 (Oct.) 1933.

4. Clay, G.: Angioid Streaks of the Retina and Pseudoxanthoma Elasticum, Tr. Sect. Ophth., A. M. A., 1932, p. 182; Arch. Ophth. **8**:334 (Sept.) 1932.

5. Collins, T. B.: On the Aetiology of Angioid Streaks in the Fundus Oculi, Tr. Ophth. Soc. U. Kingdom **43**:273, 1923.

6. Law, F. W.: A Contribution to the Pathology of Angioid Streaks, Tr. Ophth. Soc. U. Kingdom (pt. 1) **58**:191, 1938.

7. Wassenaar, T.: Angioid Streaks of the Fundus Oculi, Am. J. Ophth. **16**: 759 (Sept.) 1933.

8. Holloway, T. B.: Angioid Streaks: Report Concerning Two Cases, Tr. Am. Ophth. Soc. **25**:173, 1927.

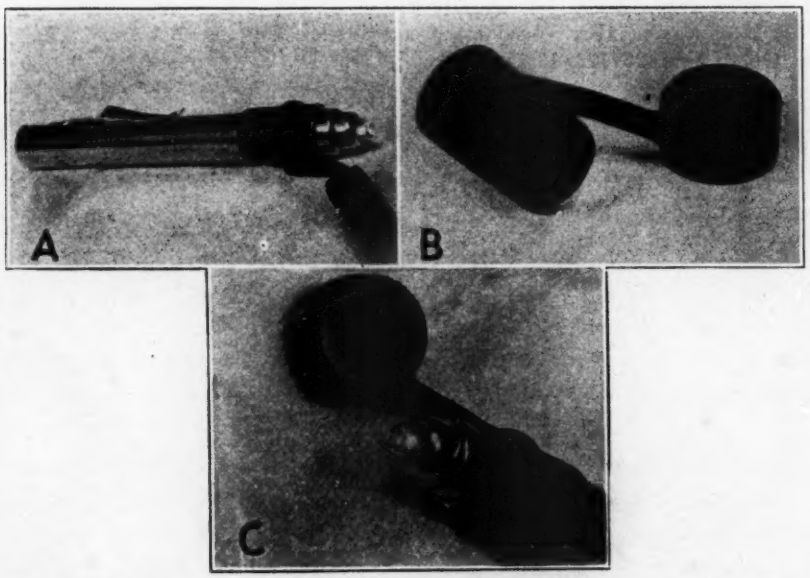
Clinical Notes

FOCUSING MAGNIFIER ATTACHMENT

EMANUEL KRIMSKY, M.D., BROOKLYN

Because of the added advantages of the new penlight lamp with its new style solid glass bulb which renders a concentrated beam of light, I have found it useful to construct a magnifying lens attachment which would enlarge its scope beyond that for which it was intended.

For this I have devised a simple unit consisting of a collar through which the flashlight can be easily slipped, a connecting bracket and a



Focusing magnifier, showing it attached to the flashlight (*A* and *C*) and as a free bracket (*B*).

lens mount which has incorporated in it a 6 × double aplanatic lens. This attachment fits firmly around the battery handle. The lens is so tilted that its focal point meets the beam of light. The entire unit is firm and light and, moreover, breakage of the flashlight, as so frequently happens, permits the attachment to be readily transferred to a new lamp with little additional cost. The bracket is firm and inflexible.

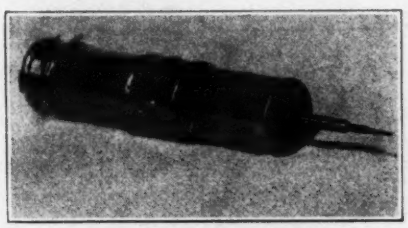
Presented before the American Academy of Ophthalmology and Otolaryngology, Oct. 10, 1938.

BATTERY-DRIVEN CORNEAL BURR

EMANUEL KRIMSKY, M.D., BROOKLYN

Not long before his death Dr. Isadore Goldstein requested me to construct for him a few instruments, and the one described here was made at his suggestion.

The construction of this device was rather simple. An ingenious battery-driven revolving fan, made on the Continent, was deprived of its blades and in place of them a cylindric collar was attached, into



Battery-driven corneal burr.

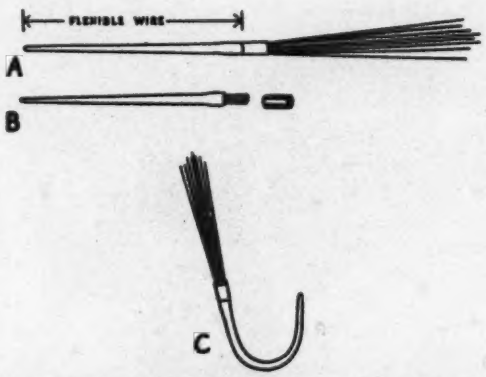
which the operator could readily insert any of the standard dental burrs. The handle itself is a somewhat compact unit, consisting of a generator operated by two batteries. The entire outfit occupies surprisingly little space. The speed of this motor was found to be satisfactory for general requirements—about 500 revolutions per minute —and could be readily reduced by the simple application of the index finger to the projecting rod. The whole unit can be easily held in the hand.

Presented before the American Academy of Ophthalmology and Otolaryngology, Oct. 10, 1938.

A FLEXIBLE NEEDLE FOR THE O'CONNOR CINCH OPERATION

M. E. SMUKLER, M.D., PHILADELPHIA

This report is a brief description of a modified Hosford-Hick needle combined with a flexible tip. The needle is made by replacing the short rigid tip of the Hosford-Hick needle with a wire tip, which is gradually tapered to a blunt end. The flexible tip is 1¼ inches (3 cm.) long and is made of 14 gage wire.



A, diagrammatic drawing showing the needle threaded with cable consisting of eight strands of medium dermal sutures. *B*, cuff of the needle removed, showing the shank through which are inserted the strands of dermal sutures. *C*, drawing demonstrating the flexibility of the needle. It is easily bent to any desired shape, greatly facilitating the passing of the cable of dermal strands between and around the muscle strands when the O'Connor cinch operation is performed. These drawings are approximately one-half actual size.

The flexible tip is easily bent to any desired shape, so that for the O'Connor cinch operation [1] the needle will pass smoothly between the muscle strips without the use of a needle holder.

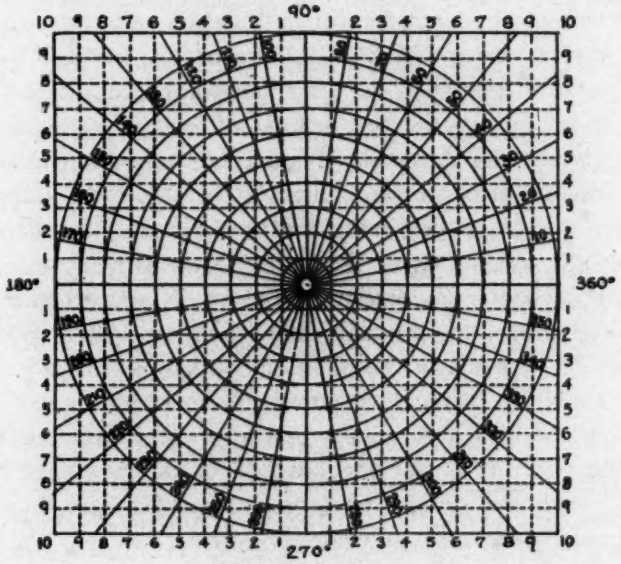
1. Smukler, M. E.: Simplification of the O'Connor Cinch Operation, Arch. Ophth. **19**:930 (June) 1938.

COMPOUND PRISM CHART

THOMAS D. ALLEN, M.D., CHICAGO

With the increasing study of muscles the ophthalmologist is more and more finding it beneficial in ordering prisms to give both lateral and vertical effects. He has previously trusted the optician to combine these with lenses. The optician consults his compound prism chart in order to grind the lens correctly. It has seemed to me more logical to write the complete order as one wishes it, and this can be done by consulting the prism chart.

It has been a good many years since a compound prism chart has been published. Practically all of the charts are made for the manufacturing optician. Consequently, the zero begins on the horizontal



Compound prism chart.

meridian at the left side and proceeds above the horizontal meridian to the right, clockwise, so that when the physician faces the patient it becomes necessary for him to transpose the axes in writing his prescription. With the new chart the reading is counterclockwise. Also, the size of the new chart is better. The others have been so large as to be unwieldy in the office.

One may obtain the proper combination by consulting the chart. For example, for 4 prism diopters base in and 2 base down on the right eye, order 4½ base in and down at axis 334 and specify right eye. For 3 prism diopters base out and 4 base up before left eye, order 5 base out and up at axis 53 and specify left eye.

Any combination is thus easily ordered, with the base (or apex) in any direction one wishes.

Ophthalmologic Reviews

EDITED BY DR. FRANCIS HEED ADLER

PRESENT STATUS OF KERATOPLASTY

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A review of the textbooks of only a few years ago showed that results of corneal transplantation were as discouraging as those obtained with the treatment of retinal detachment. In the past few years progress in the surgical treatment of retinal detachment has led to favorable results in detachments such as were heretofore considered incurable. Likewise, improvements in the technic of corneal transplantation in recent years have made it possible for a good many unfortunate persons who were doomed to permanent blindness from corneal scars to regain vision. The reports of Elschnig, Filatov, Thomas, Friede, Strakhov, Rycroft, Wright, Wasjutinskij, Sterenberg, Nazarov, Towbin, Feldman, Franceschetti and Streiff, Stallard, Kirwan, Nižetić, Ochi, Majewski and myself suggest that although there may be still a great deal of improvement to be made in this field of ophthalmic surgery, the results already obtained by many surgeons are consistently good enough to justify the inclusion of keratoplasty among the routine operative procedures on the eye. It is not the purpose of this presentation to deal exhaustively with the subject of corneal transplantation but merely to present in condensed form its present status.

The main points to be covered in this presentation are: (1) source of donor's material, (2) types of keratoplasty and (3) technics of keratoplasty employed by the surgeons who have pioneered in this type of work and whose methods are most widely used at present (Elschnig, Filatov, Thomas and myself).

SOURCE OF DONOR'S MATERIAL

The transplant may be obtained from the same subject (autotransplant), from a subject of the same species (homotransplant) or from a subject of a different species (heterotransplant). Autotransplants and homotransplants offer the best material that can be used. Hetero-

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transplants have been extensively used by me on animals and in a few special instances on human beings. I have found that heterotransplants almost invariably become opaque. The postoperative course when this type of material is used is marked by a severe reaction of the host. When successful autokeratoplasty or homokeratoplasty is performed, the reaction of the host is slight. A comparative analysis of the results obtained with autotransplants, homotransplants and heterotransplants shows that when the proper technic is used excellent results may be obtained with the first two types of transplants and that heterotransplants almost invariably become opaque, rendering them unsuitable for optical purposes. In autokeratoplasty the normal cornea of a patient's blind eye replaces the scarred cornea of his other eye. Homotransplants may be obtained from patients who have ocular lesions and require enucleation but whose corneas are normal, from cadavers of adults or infants whose eyes are enucleated shortly after death or from stillborn infants whose eyes are enucleated shortly after delivery. If the recipient is not at hand at the time of the enucleation of the donor's eye, autolysis of the enucleated eye can be retarded from two to five days by keeping the eye in Ringer's solution or in physiologic solution of sodium chloride at a temperature of 2 to 3 C. I experimented with different solutions, namely, autoserum, homoserum, heteroserum, Ringer's solution and physiologic solution of sodium chloride, and found that the last two preserved the donor's material just as well as the first three.

TYPES OF KERATOPLASTY

Corneal transplantation may be of several types:

(*a*) Total keratoplasty, wherein the entire cornea is transplanted as a whole, with or without 2 to 3 mm. of surrounding conjunctiva. This type of operation in all the cases reported in the literature resulted in failure. The method offers only a temporary improvement of vision, the implant invariably becomes opaque, and the eye is in danger of being lost through secondary glaucoma or phthisis bulbi.

(*b*) Circumscribed superficial or lamellar keratoplasty, wherein a circumscribed, superficial portion of an opaque cornea is replaced by similar tissue from a transparent cornea. This type of operation is applicable only in cases in which the lesions are superficial. Superficial lesions rarely extend over the whole surface of the cornea, and optic iridectomy is indicated in most instances instead of keratoplasty. When the opacity is extensive, it may be necessary to perform a keratoplastic operation, although the formation of connective tissue at the base of the transplant defeats the success of the operation for visual purposes.

(*c*) Circumscribed or partial penetrating keratoplasty, wherein a variable area of full thickness of the opaque cornea is replaced by a

corresponding segment of transparent cornea. This type of operation has offered, up to the present, the best permanent results. In recent years numerous technics have been described, all of them except mine being modifications of the von Hippel technic described in 1887. The four technics of this type most widely used nowadays are those of Elschnig, Filatov, Thomas and myself. These technics will be dealt with briefly.

TECHNICS OF PARTIAL PENETRATING KERATOPLASTY

(*a*) *Elschnig's Technic.*—Elschnig's technic is a slight modification of von Hippel's. Von Hippel's trephine of from 4 to 5 mm. in diameter is used to remove from an opaque cornea a disk of full thickness, which is replaced by a similar disk of transparent cornea (fig. 1 *A*). A bridge suture is placed from the conjunctiva of the upper limbus over the transplant and tied in a similar position to the conjunctiva of the opposite side. Physostigmine salicylate is used before the operation in order that the pupil will be contracted, protecting the lens from possible injury. The operation is performed under local anesthesia. Palpebral akinesia, retrobulbar injection of procaine hydrochloride and epinephrine hydrochloride and suturing of the superior rectus muscle add safety to the operation. The transplant is obtained from a patient's eye or from the eye of an adult or an infant enucleated shortly after death. Elschnig expressed the belief that any kind of solution is injurious to the transplant; therefore, he keeps the graft between layers of dry gauze after it has been excised with the trephine.

Elschnig concluded that the circumscribed, penetrating keratoplasty of von Hippel is the only dependable method. He expressed the opinion that it will be successful for about 22 per cent of all patients with leukoma who are more than 14 years of age, whose anterior chamber is normal and who give no evidence of increase of ocular tension and for about 73 per cent of those with interstitial keratitis. Transplantable material, he stated, can be obtained from the eyes of young as well as of old persons with normal corneas; it is immaterial whether the remaining part of the anterior segment is normal or pathologically changed or whether the donor has glaucoma or hypotension. Elschnig did not find any relation between hemolysis or agglutination of the serum and the transparency or opacification of the transplant.

(*b*) *Filatov's Technic.*—Filatov has modified von Hippel's operation, trying to eliminate its disadvantages, namely, the imperfect way in which the transplant is held in position and the unfortunate ease with which the iris and lens can be injured with the trephine. A flap is made in the upper bulbar conjunctiva (fig. 1 *C*), and an incision is made in the lower bulbar conjunctiva near the lower limbus. With a cataract

knife, a puncture and a counterpuncture are made in the cornea, leaving, therefore, two parallel perforating incisions through which a strip of celluloid (prophylactic spatula) is passed, penetrating the anterior chamber and separating the cornea from the iris and lens. The cornea is trephined, and a transparent graft taken from an eye of a patient or from an eye enucleated from a cadaver shortly after death is placed in position. The conjunctival flap, with its epithelial surface downward, is stretched over the transplant and fastened with two sutures to the incision in the lower part of the conjunctiva near the limbus. The strip of celluloid is then removed. In case it is impossible to use the

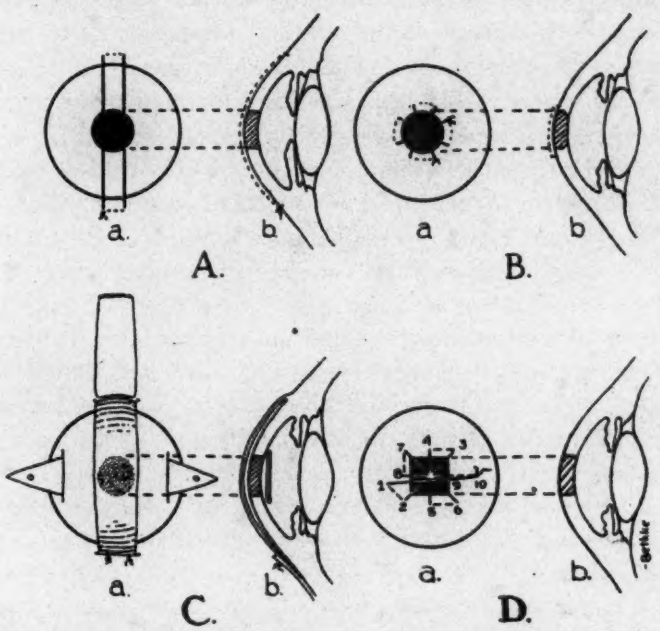

Fig. 1.—Technics of circumscribed penetrating keratoplasty: *A*, Elschnig's technic; *B*, Thomas' technic; *C*, Filatov's technic, and *D*, my technic.

conjunctival flap because of scar tissue, a small round piece of the membrane of a boiled egg, with its inner surface toward the implant, is used instead. Radial incisions are made in this membrane for better fitting, and bridge sutures in the manner of Elschnig are placed vertically and horizontally for fixation of the egg membrane and the implant. More recently Filatov has devised a combination of a hand trephine with a safeguarding spatula (Filatov and Marzinkowsky), which facilitates the performance of his operation.

Filatov classified his cases as follows:

> . . . according to the quality of the operative field: (*a*) In eyes with leukomas complicated with glaucoma, buphthalmos, aplanation of the cornea and

symblepharon, corneal transplantation gives no positive results. (*b*) In rough cicatricial leukomas only in a few cases can permanent transparency of the transplant be obtained. (*c*) Successful transplantation may be done only in cases of leukoma in which some transparent corneal tissue remains.

Filatov's experience confirms that of Elschnig, that it is of great importance to have some normal corneal tissue in the leukoma in order to obtain successful corneal transplantation. Filatov has used extensively grafts obtained from cadavers' eyes and has found them as satisfactory as those obtained from the corneas of living persons.

(*c*) *Thomas' Technic.*—A trephine from 4 to 4.5 mm. in diameter is used to outline a disk in the leukomatous cornea (fig. 1 *B*). Then the trephine is sloped to about 45 degrees and rotated so as to cut through at one point. Through this point one blade of a pair of scissors penetrates into the anterior chamber, and the remaining inner layers of the outlined corneal flap are cut in a shelving manner, so that the endothelial aspect of the disk is smaller than the epithelial surface. With a trephine slightly smaller than the one used in the host, a similar disk is obtained from a transparent cornea. The leukoma is replaced by the graft and is kept in position by cross stitches previously inserted into the cornea a short distance from the graft itself.

Thomas attaches considerable importance to the size of the transplant in its relation to the size of the defect. The transplant should be smaller than its bed, since the former undergoes some swelling, and if it is originally of the same size as the latter, the result is a bulging cicatrix with irregular edges. In Thomas' technic the transplant is firmly held in position by cross stitches. The shelving of the transplant prevents it from falling into the anterior chamber, and a dilated pupil prevents anterior synechiae. The transplant is obtained from the eye of a patient and is kept in physiologic solution of sodium chloride for a short while before it is finally placed in the eye of the host.

Thomas used to keep the transplant, before placing it in the eye of the host, in olive oil. Recently he found that olive oil might lead to later damage of the transplant; therefore, he now uses saline solution instead of oil. In his last publication Thomas described a modification of his technic by which the stitches were inserted in such a manner that the knot will not slide over the flap or the edge of the flap.

My Technic.—The pupil is widely dilated with atropine. The leukomatous area of cornea to be removed is outlined with a double-bladed knife without penetrating into the anterior chamber (fig. 2 *A, B* and *C*). A continuous corneal suture is inserted outside the edges of the outlined square (fig. 2 *D*). This suture will be destined to hold the transplant in position. Another suture is inserted within the outlined leukoma to facilitate the removal of this segment (fig. 2 *E*). The outer edge of

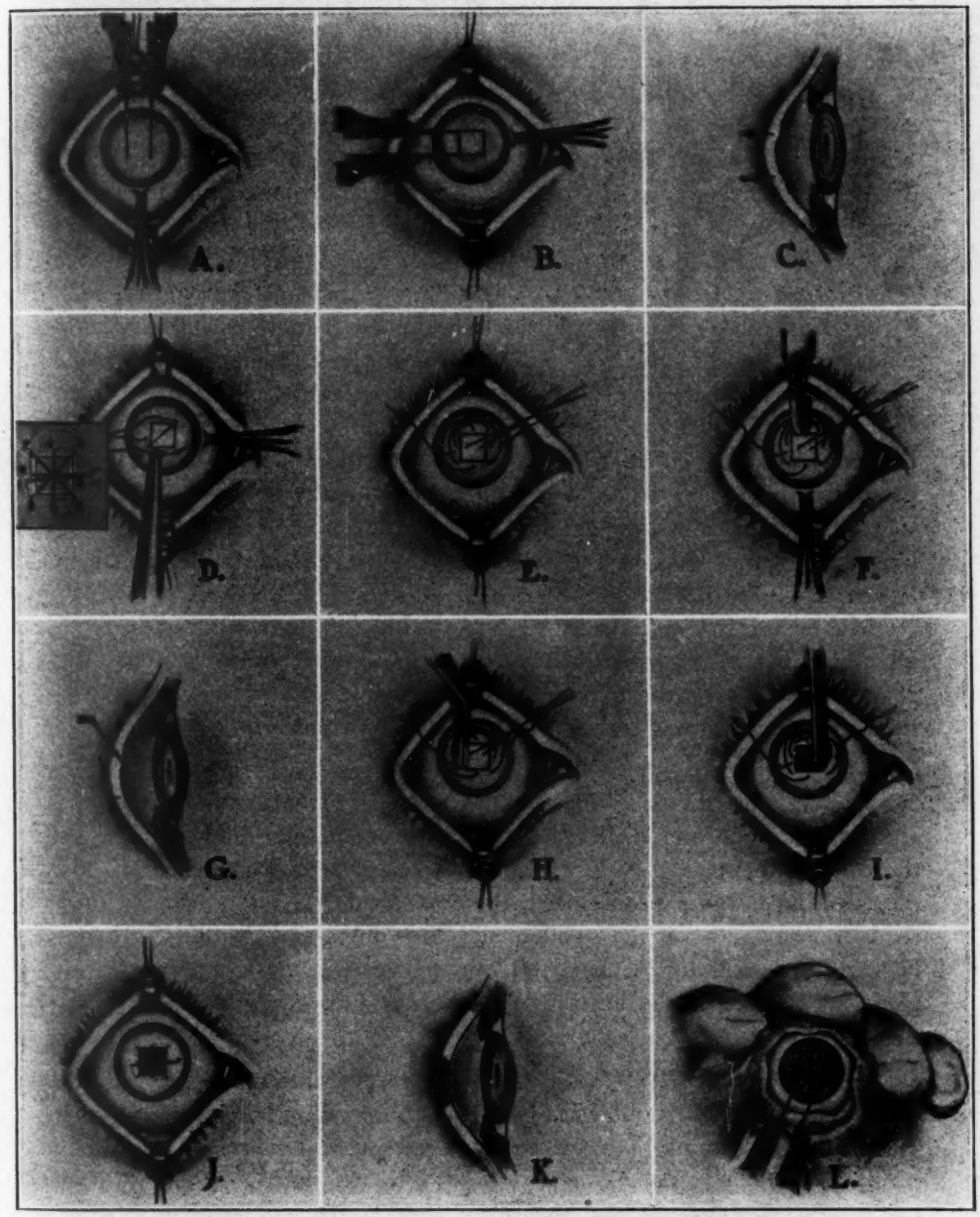

Fig. 2.—My technic of partial penetrating keratoplasty.

the leukoma is cut through with a keratome kept at an angle of about 20 degrees in order to obtain shelving of the edge (fig. 2 *F* and *G*). The other three edges are also cut in a shelving manner with the aid of special scissors (fig. 2 *H*). During this last manipulation, a gentle pull is exerted on the suture to keep the leukoma away from the lens, thus preventing injury to this structure. The transplant, equal in size and shape to the removed leukoma, is obtained in a similar manner (fig. 2 *L*) from the enucleated eye of a patient or from the eye of a stillborn infant enucleated shortly after delivery and kept from one to forty-eight hours in Ringer's solution or in physiologic solution of sodium chloride at a temperature of from 2 to 3 C. The clear transplant replaces the dissected leukoma (fig. 2 *I*), and the continuous corneal suture is gently made taut (fig. 2 *J* and *K*). The corneal suture is removed from four to six days after the operation. In operating on patients with corneal opacities due to trauma, many eyes are found, especially among those burned with caustics, in which a speculum cannot be used because of pronounced symblepharon. To obviate this difficulty and without having to resort to the insertion of sutures in the eyelids, I have been using with satisfactory results the small lid clamp retractors illustrated in figure 2.

My technic of circumscribed penetrating keratoplasty varies from all others heretofore described in three important points, namely, the shape of the graft, the manner of dissecting it and the use of a continuous corneal suture to hold the transplant in position.

I claim that:

1. Beveling of the transplant prevents it from falling into the anterior chamber, and 20 degrees from the vertical meridian seems to be the correct degree of beveling in order to obtain good cicatrization. If the beveling is more pronounced, the transplant has a tendency to protrude forward, becoming swollen and thus impairing healing. If the beveling is less than 20 degrees from the vertical meridian, the transplant may fall into the anterior chamber or into the vitreous body if the lens is absent.

2. Rectangular flaps can be more easily beveled than circular ones.

3. The use of the double-bladed knife followed by the use of scissors gives cleaner sections than the trephine-scissors combination.

4. The smaller the circular graft, the more difficult it becomes to bevel its edge with scissors.

5. The continuous suture used by me to hold the transplant in position offers uniform pressure. The knot of the suture lies away from the edge of the transplant in such a manner that it does not slide over the graft or over the edge of the graft. I do not dissect the transplant until the leukoma from the eye of the host has been excised. The

transplant is then transferred to the eye of the host without placing it in any solution unless some iris pigment adheres, in which case the transplant may be washed with physiologic solution of sodium chloride.

At first I used conjunctival flaps, thinking that they were the ideal means of applying uniform pressure on the transplant in order to hold it in position. It was believed that conjunctival flaps accelerated the healing process, nourishing the graft during the first few days after operation. However, after performing 21 operations on human eyes, a transplant became detached. After studying 21 keratoplasties performed with the use of the conjunctival flap, I concluded that in some cases the conjunctival flaps do not maintain sufficient pressure to hold the transplants in position. This need for a securely fastened graft is particularly evident when the intraocular pressure is elevated and with unruly patients. Although a conjunctival flap protects the eye in case the transplant becomes detached, as occurred in one of the cases in which I performed the operation, it has a tendency to become adherent to the edges of the transplant if it becomes partially detached. It also tends to leave the eye irritated, prolonging postoperative recovery.

Sutures to hold a graft effectively in position must be inserted into the cornea of the host close to the transplant. If the sutures are placed far from the edges of the transplant, at or beyond the limbus, they have too much mobility and become loose shortly after their insertion, thus defeating the purpose of holding the transplant in position. If the sutures are placed through any part of the graft, partial or total opacification of the latter occurs. Care must be taken not to fasten the sutures too tightly, because if this is done they leave a permanent nebulosity and tend to press on the transplant, especially when it is edematous. During the first four or five days after operation the sutures remain clean, but if they are allowed to remain for a longer period they macerate the corneal tissue, may become infected and may cause an opacity in the transplant, which is seen clinically as a linear nebula going across it. If they are retained too long, an ulcer or an abscess may form either in the cornea of the host or in the transplant, leading to its total opacification. Sutures hold the transplant in position so effectively that operation may be performed at any age, whether with local or general anesthesia. Local anesthesia is preferable; general anesthesia is used only for children or for extremely nervous patients.

Comparison of the results obtained by holding the grafts in place with conjunctival flaps and with corneal sutures shows the latter method to be more effective, but only if the sutures are inserted in the host's cornea near the transplant.

Both experimentally on animals and clinically on human beings it was observed that healing of the transplant was best obtained when the transplant was of the same size as the defect in the leukomatous

cornea of the host. Healing took place in these cases without tendency to swelling of the transplant. The transplant appeared transparent during the first few days after the operation. In no instance when the apposition of the edges was perfect did I find a tendency of the transplant to protrude. When the transplant was larger than the defect in the cornea of the host, it had a tendency to protrude. Unless the sutures were placed loosely, they pressed on the transplant, causing permanent cloudiness on its surface. If the transplant was smaller than the opening made in the cornea of the host, it was observed microscopically in animals' eyes that the edges of the transplant were not in perfect apposition with the edges of the host's cornea, particularly the endothelium and Descemet's membrane. This last membrane had a tendency to curl inward, leaving a gap of unprotected corneal stroma, which quickly filled with fibrin. If the iris came in contact with this fibrinous material, anterior synechiae had a tendency to develop. The transplant appeared more edematous in these cases during the first few days after the operation than in the two previously described conditions.

I have performed more than 150 keratoplasties on unselected eyes, following my technic or some of its modifications. In the first 21 operations conjunctival flaps alone were used to hold the transplant in position. A few more were performed with a combination of corneal sutures and a conjunctival flap. In the past two years the conjunctival flap has been eliminated entirely, the transplant being held in position with a continuous corneal suture. Eyes requiring corneal transplantation may be classified into two main categories: favorable and unfavorable. Those eyes are favorable (1) in which there is normal intraocular tension; (2) in which the diseased ocular tissue is confined to the cornea; (3) in which the leukoma is not very dense although sufficient to cause considerable impairment of vision and (4) in which there are areas of clear or slightly scarred cornea surrounding the graft. Eyes with leukomas in the pupillary area, interstitial keratitis and advanced keratoconus in which vision is not improved with contact glasses or which do not tolerate contact glasses well seem to be particularly favorable for keratoplasty.

Unfavorable eyes include (1) those with very dense leukomas extending over the whole or almost the whole cornea; (2) those with aphakia; (3) those with increased tension; (4) those with corneal cloudiness and densely vascularized pannus, and (5) those with anterior or posterior synechiae.

When the operation is performed on favorable eyes (fig. 3 *A* and *B*), a high percentage of success (more than 90 per cent) may be expected with permanently clear transplants and considerable improvement of vision. In 3 of my cases vision improved from perception of hand movements or counting of fingers at 1 foot (30 cm.) to 20/15. One case in which bilateral keratoplasty was done is worth mentioning.

Vision improved in one eye from perception of hand movements to 20/20 and in the second eye from counting of fingers at 1 foot to 20/20.

In those eyes in which the anterior segment of the eyeball is severely affected (fig. 3 *C* and *D*) such brilliant results cannot be expected, but a definite improvement can be obtained when a suitable technic is used. As these eyes have little or nothing to lose and may be considerably improved, operation is justified. In this group of unfavorable eyes, preliminary operations are sometimes necessary before corneal transplantation in order to prepare the eye for a more successful final keratoplasty. The preliminary operations required by some of these eyes are: operations to combat glaucoma, removal of synechiae whenever possible,

Fig. 3.—*A*, an eye with a central corneal opacity and a normal anterior chamber, favorable for keratoplasty. *B*, a transparent corneal graft in a favorable eye. *C*, an eye with extensive leukoma and anterior synechiae, unfavorable for keratoplasty. *D*, an eye with extensive pannus following a chemical burn, unfavorable for keratoplasty.

preliminary iridectomy when the pupil does not dilate readily and the removal by electrodesiccation or by any other method of as many vessels as possible in cases of pannus and resection of segments of cornea in order to obtain an approximately normal curvature when staphyloma is present. Finally, in cases in which the whole cornea has been transformed into dense scar tissue, it may be necessary to perform first a series of transplants in mosaic to replace the dense scarring throughout the cornea by more permeable tissue and then to perform the last corneal transplant for visual purposes.

I found that corneas obtained from stillborn infants or infants who died a few hours or a few days after delivery are as good as those

obtained from enucleated eyes of adults, provided the material is obtained shortly after the death of the infant.

On account of the scarcity of donor's material, I obtain as many transplants as possible from each cornea. When the whole cornea of the donor is transparent in adults' eyes, as many as four grafts may be obtained.

In a few cases I have used a special trephine which makes the transplants round. The technic is similar to that used for the square transplant made with the double-bladed knife, the same type of continuous suture being used to hold the transplant in position. The trephine is used to outline the leukomatous disk to be removed and the graft itself and to perforate the cornea. The remaining uncut cornea is severed with special curved scissors. Since this last technic has not been used often enough, I do not feel prepared to discuss it at present.

Confirming the opinion of Elschnig, I found that blood grouping of the host and donor in cases in which corneal transplantation is to be done seems to have no relation to the success or failure of the operation.

COMMENT

Corneal transplantation is becoming increasingly popular. The results already obtained are sufficiently encouraging to justify its inclusion among the routine surgical procedures of ophthalmology. The operation is not difficult to master for the well trained ophthalmologist. Of the different technics of keratoplasty now in use, it is difficult to say which would give the best results in the hands of the average surgeon. In this regard, individual adaptability to a special technic plays an important role. Those who have become acquainted with a certain operation may find it difficult to change to another technic giving good results in the hands of other colleagues. As in any other field of surgery, each technic has its advantages and disadvantages, and it is by extensive research made by many persons that one may state which technic gives the highest percentage of good results or which is specially suited for individual cases.

One of the main drawbacks in corneal transplantation is the scarcity of donor's material. A good many eyes the corneas of which could be used for transplantation require enucleation. Cooperation among colleagues will make it possible to perform a greater number of keratoplasties when this material is made available. Cadavers' eyes may at some time in the future be more available in this country, thus permitting more ophthalmologists to perform a greater number of keratoplasties. When the operation for corneal transplantation is more widely used, the tendency of the public and the press to dramatize this procedure will be lessened.

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News and Notes

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GENERAL

The New York 1939 World's Fair Exhibit on the Conservation of Vision.—The advisory committee on medicine and public health of the New York World's Fair, of which Dr. Louis I. Dublin and Dr. Victor Heiser are members of the executive committee, appointed a committee to prepare an exhibit on the conservation of vision. Dr. John M. Wheeler was selected as chairman. On his death, Dr. Daniel B. Kirby was asked to assume his duties for the organization of the exhibit. The members of the committee are: Dr. Conrad Berens; Mr. Lewis Carris, National Society for the Prevention of Blindness; Mr. Homer N. Calver, director of medical exhibits, New York World's Fair; Dr. John Evans; Dr. M. E. Frampton, principal, New York Institute for the Education of the Blind; Dr. Bruno Gebhard, technical consultant; Dr. LeGrand Hardy; Miss Grace S. Harper, New York State Commission for the Blind; Mr. M. Julian; Miss Eleanor Mumford, associate for nursing activities, and Dr. Webb W. Weeks. The expenses of the exhibit are borne by the sponsor, the New York Institute for the Education of the Blind. The principal of the Institute, Dr. M. E. Frampton, has a broad view of the purposes of the exhibit. He has cooperated to the utmost to portray the eye in health and in disease in a graphic way to the lay public who will visit the Hall of Medicine, in which the exhibit is housed at the World's Fair.

The origin and development of the eye and its anatomic structure, physiologic function and pathologic conditions are portrayed in beautiful, artistic transparencies in color. Twelve illuminated panels with six to ten pictures each tell the story. The presence of the blind students from the New York Institute for the Education of the Blind brings home in a vivid and striking way the necessity for the program of the prevention of blindness. The members of the committee held numerous meetings and devoted much time individually to the selection of material and to the elaboration of new methods of presentation of a technical subject to a lay public in understandable terms. That success has been achieved is to be judged by the great interest and attendance.

The subjects which are presented are: embryology, anatomy, optics, the effect of various diseases and poisons, the results of accidents and their prevention, the effect of inflammations and infections of the eye and general system and their prevention and treatment, cataract, glaucoma and strabismus.

Cooperating in the production of the transparencies were: the American Board of Ophthalmology; the Eye Surgery Fund; the Institute of Ophthalmology, which contributed part of the art material of G. Bethke, M. Quinlan and A. Marfaing; the Department of Ophthalmology of the State University of Iowa; the National Society for the Prevention of Blindness; the New York State Commission for the Blind, the Ophthalmology Fund and the Lighthouse.

The New York Institute for the Education of the Blind, through Dr. M. E. Frampton and Mr. Paul Mitchell, adopted as its purpose the education of the public regarding the normalcy of blind persons and the manner of their adjustments to blindness. The spoken word is exemplified by vibration aids in the education of the deaf-blind and symbolized through the radio to show vocational possibilities for the sightless. Emphasis is placed on the written word by the use of the Braille machine to convey information from the sighted to the blind and by the use of the typewriter to carry it from the blind to the sighted. The progress of the blind in literature, science, mathematics and in the arts and crafts is exemplified by blind students who exhibit their attainments in brief working periods at the Fair. Along the top of the main wall of the exhibit hall is the motto "And I Shall Lead the Blind By a Way They Knew Not," with a transcription in enlarged Braille just below the motto, each Braille letter being directly below its corresponding printed letter.

The actual presence of the blind in connection with their problems of education and vocational nature must emphasize the need for the prevention of blindness and make for a better understanding of the blind. It will make easier the problem of the ophthalmologist and those who are associated with him in the care of the eyes of the public.

Course in Glaucoma.—The staff of the Illinois Eye and Ear Infirmary will conduct an intensive study of glaucoma, beginning Sept. 11, 1939. The course of study will continue through five days, from 9 a. m. to 5 p. m. A round-table discussion will be conducted each day at luncheon. The luncheon will be furnished at the infirmary.

Only two hours each day will be devoted to lectures. Registrants will receive practical instruction and an opportunity to practice the different methods of diagnosis on patients. Various types of surgical treatment for glaucoma will be demonstrated by the attending staff, following which the registrants will practice the same operations on kittens' eyes under the supervision of the attending surgeons. Lectures and demonstrations will be given by Drs. Harry Gradle, Robert von der Heydt, Thomas Allen, Samuel J. Meyer and other members of the staff.

The course will be limited to ten physicians who are practicing ophthalmology either with or without otolaryngology. The fee for the course is $75. Registrants will be accepted in the order of receipt of their applications. Further information may be obtained from Dr. Samuel J. Meyer, secretary of the course, Illinois Eye and Ear Infirmary, 908 West Adams Street, Chicago.

The S. Lewis Ziegler Prize.—The Section on Ophthalmology of the College of Physicians, Philadelphia, announces the S. Lewis Ziegler Prize. This is an award of $100 for the best piece of original work in ophthalmology accomplished in any one year from October 1 to September 30 inclusive.

Descriptive reports are to be submitted anonymously at the first meeting of the section in October to duly appointed judges, who shall make their award or report not later than December 31 of that year.

The interest only of this endowment fund, when amounting to $100, shall constitute the prize.

The report or reports submitted shall in the discretion of the judges be of sufficient merit or importance to justify the award; otherwise, the interest accruing above the requirement of one award shall be turned back to the principal sum.

American Board of Ophthalmology.—The American Board of Ophthalmology will conduct a written examination on Aug. 5, 1939, and on March 9, 1940. Formal application must have been received before July 1 for the August examination and must be received before Jan. 1, 1940, for the March examination. The oral examination will be conducted in Chicago on Oct. 7, 1939, and in New York on June 10, 1940. Further information may be obtained from the secretary, Dr. John Green, 6830 Waterman Avenue, St. Louis.

SOCIETY NEWS

National Committee of the International Association for Prevention of Blindness.—The meeting of the national committee of the International Association for Prevention of Blindness was held at the same time as the meeting of a subcommittee of the Hungarian Society of Hygiene, at the Semmelweis hall, the Royal Society of Medicine, Budapest, Hungary, on March 14, 1939. The Countess Julius Károlyi was in the chair. Professor de Grósz, president of the committee, discussed the sight-saving activities generally adopted. Preventive measures for blindness were accurately described fifty years ago in a booklet written by Fuchs, then professor in Liège and later in Vienna, which was given a reward by the society.

In Egypt the preventive measures diminished the enormous rate of blindness to one third due to the merit of the great organizer MacCallan. The most effective method consists in creating ophthalmic hospitals, departments and dispensaries and in furthering popular education, enlightenment and the achievement of a higher social standard. The Hungarian legislation (against trachoma, 1886 and 1903) is based on the same principles. The National Committee intends to decrease indolence by propaganda.

G. Horay reviewed the diseases widespread among the population that cause blindness or inability to see clearly (syphilis, tuberculosis and trachoma). Statistics drawn up on the basis of patients treated at the Eye Hospital No. 1 of the Budapest University were presented. A. Gaál, chief of department at the State Hygiene Institute, discussed the preventive role played throughout the country by the Green Cross Movement, a public health organization. Lastly, I. Csapody gave a lecture on sight-saving classes.

Prof. Julius de Darányi, president of the Hungarian Society of Hygiene, expressed the hope that he would be able to secure active support on behalf of the society and the municipality.

Obituaries

EDWIN MILTON BEERY, M.D.

1871-1939

By the death of Dr. Edwin Milton Beery, Brooklyn lost an ophthalmologist whose personality left an indelible stamp not only on his professional confreres but on all who met him in a social way.

The human touch which Dr. Beery applied to his work in consulting room and hospital brought that atmosphere which one usually associates only with the "kindly manner of the family doctor." He never had about him the impersonal quality which is so likely to surround the specialist. Perhaps this personal quality was acquired from his southern forebears.

Dr. Beery was born on July 12, 1871, near Edom, Va., the son of Noah W. and Kate V. Neff Beery. His ancestors came to Pennsylvania from Switzerland in 1636 and later migrated to Virginia. Dr. Beery graduated from Bridgewater and from Roanoke College in Virginia and took his medical degree at Bellevue Hospital Medical College in New York in 1897.

Early in his medical career Dr. Beery served on the staff of the Hebrew Guardian Society, the Riverside Hospital and the Willard Parker Hospital in New York. He served as an expert for the New York City Board of Health for many years, and before his retirement from the board in 1925 he was assistant director of the department of hospitals and medical inspector for the Queensboro Hospital. Dr. Beery was appointed to the staff of the Brooklyn Eye and Ear Hospital in 1907; he was made surgeon in 1927 and senior surgeon in 1936. For many years he was director of the department of ophthalmology of the Brooklyn Jewish Hospital and consultant in ophthalmology in the Kingston Avenue Hospital.

Dr. Beery supported the aims of the American Board of Ophthalmology by obtaining the certificate as a stimulus to his staff to do likewise. He was a member of his state and county medical societies and a Fellow of the American Medical Association. He was a charter member of the Brooklyn Ophthalmological Society.

As a staunch churchman, Dr. Beery served as ruling elder of the Classon Avenue Presbyterian Church. He was a member of the Brooklyn Lodge 288, F. & A. M., Orient Chapter, Damascus Commandery and Kismet Temple, Phi Delta Theta, the New York Southern Society, the Virginians and the Tuscorara Club. Dr. Beery was an expert trout fisherman, and one was truly fortunate who met him on the stream.

Dr. Beery died of heart disease on Jan. 30, 1939. He is survived by his widow, the former Minnie L. Newman, of Harrisonburg, Va.; two sons, Dr. Edwin Newman Beery, who has been associated with his father in practice for the last year, and John Moffett Beery, and four sisters, Mrs. Samuel A. Hoover, Mrs. David Beery, Mrs. Joseph W. Gile and Mrs. D. A. Swank, all of Virginia.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Color Sense

STUDIES WITH THE SPECTROSCOPIC MONOCHROMATOR. A. TSCHERMAK-SEYSENEGG, Arch. f. Ophth. **139:** 181 (Sept.) 1938.

In the color circle the normal eye distinguishes four primary color sensations (*Urfarben*), of which only the primary yellow (5,700 angstrom units), the primary green (5,600 angstrom units) and the primary blue (4,700 angstrom units) occur in the spectrum. The sensation of primary red can be produced by a mixture of spectral red and violet. After some training the normal observer finds these primary colors in the spectrum with an accuracy and consistency of $\pm$ 30 angstrom units if his eyes are in a neutral state or neutral "mood" (*Neutralstimmung*) as far as color perception is concerned. This neutral mood is produced by a stay in a dark room for two and a half minutes or by exposure of the eye to so-called neutral light sources. Absence of any shift of the primary colors in the spectrum after exposure to a certain light thus becomes the criterion of neutrality. Exposure of the eye to most practical light sources causes a shift of the primary colors in the spectrum which indicates an altered, no longer neutral, state or mood of the color-perceiving apparatus. The effect of prevalence of a certain wavelength in a mixed light produces, as a rule, a shift of the points in the spectrum which correspond to the primary color sensations, toward the prevailing wavelength. If the prevailing wavelength of the mood-changing light causes, by itself, a primary sensation, then only the two neighboring primary points in the spectrum undergo the shift.

It was the object of the work reported in this paper to devise an apparatus with which the primary colors of the spectrum could be found quickly, accurately and consistently on repeated tests. By means of this apparatus it should be possible to test light sources for their neutrality or partiality. By means of correcting filters it should be possible to determine, to define and to eliminate any existing partiality of a light source.

Tschermak-Seysenegg has devised such an instrument, which has been patented in the United States under the name of spectroscopic monochromator. With this instrument the author has confirmed the laws of mood alteration which have been mentioned. If only one eye is exposed to the mood-changing light, both eyes lose their state of neutrality. Even daylight is not a neutral light. The commercial daylight lamps, as a rule, still emit too much yellow, while the filter may have added a little too much green. The instrument is suitable for the detection and study of color blindness.

P. C. KRONFELD.

Conjunctiva

A Statistical Survey of 140 Cases of Gonorrheal Ophthalmia. J. C. Geiger and R. W. Burlingame, Am. J. Ophth. 21:421 (April) 1938.

This article presents a comparison of the results obtained in cases of gonorrheal ophthalmia with the usual treatment and those obtained with this method supplemented by nonspecific protein therapy in the form of typhoid vaccine. The latter treatment appeared more efficacious.

W. S. Reese.

The Gono-Reaction in Gonorrheal Conjunctivitis. G. Mathis, Rassegna ital. d'ottal. **5:** 706 (Nov.-Dec.) 1936.

The author studied the complement fixation reaction of newborn infants affected with gonorrheal conjunctivitis to the serum of patients with gonorrhea.

He found specific antibodies which were not transmitted from mother to child. He states that in the superficial form of the disease the reaction may be negative but that in the severe forms the reaction is positive and may remain so even after the disappearance of the gonococcus from the secretion. The author believes the complement fixation test to have medicolegal value.

A. Perzia.

Total Conjunctivoplasty for Total Symblepharon Due to Pemphigus. R. Friede, Arch. f. Ophth. **139:** 323 (Sept.) 1938.

In a case of bilateral total symblepharon following pemphigus, the adhesions between the borders of the lids and the limbus were severed, the surfaces of the wounds on the globes and lids were covered with conjunctiva taken from a human cadaver and symblepharon prostheses were inserted. Most of the transplanted conjunctiva sloughed off. The prostheses were removed twice a week and the cul-de-sacs irrigated. As long as the prostheses were left in place, the conjunctival sacs remained large and the ocular movements normal. The surfaces of the sacs appeared dry and covered with some mucus. No epithelization occurred from the island of conjunctiva which had "taken." Two months after the operation the left eye was lost due to suppurative keratitis, which rapidly progressed to panophthalmitis. Three months after the conjunctivoplasty the prosthesis was removed from the right sac. A few weeks later this eye again showed the picture of total symblepharon. Thus the conjunctivoplasty failed completely in one eye and may have paved the way for the suppurative keratitis which caused the loss of the other eye.

P. C. Kronfeld.

Crystalline Degeneration of the Conjunctiva and Cornea: Report of a Case. F. Blobner, Klin. Monatsbl. f. Augenh. **100:** 588 (April) 1938.

A man, aged 45, stated that hot ashes dropped in his eyes twenty years previously. He could see well, until vision failed suddenly about June 1935. Since that time his vision remained unchanged, and the eyes were free from irritation. Rheumatism was the only etiologic factor

discovered. The conjunctiva and cornea of each eye were dotted with innumerable fine crystals, causing opalescence in oblique light. The crystals could be observed in the center of the cornea as far back as Descemet's membrane. They did not stain with fluorescein, and ethylmorphine hydrochloride did not produce any change in them. No general pathologic changes were found aside from multiple minute hemangiomas scattered all over the body and slight albuminuria. After excluding a hereditary condition, occupational disease and familial dystrophy or degeneration, Blobner concludes that the disease is a primary condition.

K. L. STOLL.

Cornea and Sclera

CONTRIBUTION TO THE STUDY OF KERATITIS DUE TO EMETINE HYDROCHLORIDE. C. GABRIÉLIDÈS, Arch. d'opht. 1: 203 (March) 1937.

The author reports a case of corneal inflammation as the result of the splashing of a few drops of 4 per cent solution of emetine hydrochloride into the eye. Conjunctivitis and keratitis with the characteristics of a superficial punctate keratitis resulted. This is the third case of this type to be published and also the third in which complete slit lamp studies were made. The condition in the case reported by Moreau was central ulceration; that in the case reported by Trantas was similar to a filamentous keratitis. In these cases the latent period varied from nine to twelve hours and was followed by the onset of sudden severe pain. The duration was from twenty-four hours to twelve days. The treatment consisted in the application of a neutral ointment and a bandage. The author refers to the work which has been done experimentally with the condition and expresses the belief that cases of this type of keratitis must have occurred more frequently than have been reported.

S. B. MARLOW.

A METHOD OF TREATING KERATOCONUS (DIATHERMOCOAGULATION). B. ALAJMO, Rassegna ital. d'ottal. 5: 654 (Nov.-Dec.) 1936.

The author reports 10 cases of keratoconus in which he used diathermocoagulation. He states that the vision in all but 2 cases was greatly improved with and without correction. In the 2 cases the vision remained the same without correction but was improved with correction.

He further states that keratoconus which is not treated surgically tends to become worse. Correction in such cases gives temporary relief, whereas in cases in which operation is performed the spherocylindric correction seems to be less and vision remains stationary. The functional results have been satisfactory. Diathermocoagulation strengthens the corneal tissue at the site and also around the coagulated area.

A. PERZIA.

NASAL SYNDROME WITH TRIGEMINAL NEURALGIA FOLLOWING A TRAUMATIC LESION OF THE CORNEA. F. AGNELLO, Riv. oto-neuro-oftal. 15: 79 (Jan.-Feb.) 1938.

Agnello describes 2 cases of a nasal syndrome with neuralgia of the trigeminal nerve following trauma to the cornea by a finger nail. Symp-

toms were primarily ocular pain and a profuse rhinorrhea. The condition was resistent to local therapy and local anesthetics. Therapy to improve the patient's constitution brought about a rapid disappearance of the neuralgia.

F. P. GUIDA.

Experimental Pathology

SYPHILITIC LESIONS PRODUCED BY THE INJECTION OF SEPTIC MATERIAL INTO THE RETRO-OCULAR CAVITY OF THE RABBIT. VAN DUYSE and VAN CANNEYT, Arch. d'opht. **1:** 35 (Jan.) 1937.

The authors injected syphilitic material into the retro-ocular cavity of 36 rabbits, with positive results in 56.8 per cent and ocular lesions in 41 per cent. Their conclusions are that a high percentage of primary and metastatic lesions result from such an injection and that the cornea is especially receptive to the production of what they call primary and secondary keratitis.

S. B. MARLOW.

TISSUE CULTURE OF DESICCATED CORNEA. V. P. FILATOV and M. A. BAJENOVA, Arch. d'opht. **1:** 385 (May) 1937.

This work has as its purpose the verification of the vitality of the dried cornea of the rabbit by tissue culture. It is the result of an earlier communication on the culture of cornea preserved at a temperature of —2 C. The authors believe that their experiments suggest that the cornea dried with a loss of 76.3 per cent of its initial weight is capable of growing, that is to say, preserves its vitality; that the growth of the desiccated cornea as compared to that preserved at a low temperature takes place later, and that the growth consists chiefly of epithelium and fibrocytes, and from this point of view differs from fresh cornea and from cornea preserved at a low temperature.

S. B. MARLOW.

INVESTIGATION OF THE PATHOGENESIS OF PAPILLEDEMA. A. CHIATELLINO and C. PRISTER, Riv. oto-neuro-oftal. **15:** 108 (March-April) 1938.

The varied theories of the genesis of papilledema are reviewed. Experiments were carried out on dogs by ligating the optic nerve at various levels to cause a lymphatic stasis within the sheath. The effect of chemical stimulation of the optic nerve was investigated. Finally, intracranial injection of inert material was tried.

Ligation produced results more nearly simulating clinical findings, but Chiatellino and Prister are reserving a final decision until further experiments are carried out.

F. P. GUIDA.

CHANGES IN THE LENSES DUE TO EXPOSURE TO HIGH FREQUENCY SOUND WAVES. E. ZEISS, Arch. f. Ophth. **139:** 301 (Sept.) 1938.

The nature and the methods of production of high frequency sound waves (called "ultrasound" by the author) are described. If explanted cattle lenses are exposed to such waves of frequencies varying from 270,000 to 381,000 (per second) for two to eight minutes, an opaque

zone resembling human perinuclear cataract develops in the periphery of the embryonic nucleus and dense leukoma-like opacities appear in the peripheral cortex ("ultra sound cataract"). One hour after irradiation the opacities disappear. During irradiation the temperature of the lenses rises from 22 to 30 C. The author believes that the opacities of the lens represent dehiscences between zones of different acoustic density which are made manifest by irradiation.

P. C. KRONFELD.

General

CAN THE DIAGNOSIS OF DISEASES FROM THE APPEARANCE OF THE IRIS WITHSTAND A THOROUGH SCIENTIFIC TEST? E. HUMMEL, Klin. Monatsbl. f. Augenh. **100**: 597 (April) 1938.

In a dissertation approved by Groenouw, Hummel presents the result of a scientific test of the so-called iris diagnosis. Again and again the claim is made by certain healers that each organ of the body is represented in one of forty fields on the surface of the iris. Disease of each particular organ is claimed to produce changes of the design in the corresponding field of the iris. Hummel examined the iris of 100 patients for whom the diagnosis had been established beyond a doubt. In 3 patients only such changes happened to occur. The fields of the remaining 97 patients either were without "signs," or they presented changes simultaneously in many sites. Actually existing diseases were manifested in the typical fields of none of these 100 patients. Hence, the iris diagnosis is an absolutely useless method.

K. L. STOLL.

General Diseases

ESSENTIAL CARDIOVASCULAR HYPERTENSION AS REVEALED IN ONE HUNDRED CONSECUTIVE EXAMINATIONS OF THE FUNDUS OCULI. F. T. TOOKE and J. V. V. NICHOLLS, Am. J. Ophth. **21**: 395 (April) 1938.

This article does not lend itself to abstracting. Several tables are given correlating the ocular and the systemic findings, and the pathogenesis of the fundus changes is discussed.

W. S. REESE.

OCULAR MANIFESTATIONS OF QUINCKE'S EDEMA: ALLERGIC PAROXYSMAL INTRAOCULAR EDEMA. L. WEEKERS and G. BARAC, Arch. d'opht. **1**: 193 (March) 1937.

Weekers and Barac review the literature on angioneurotic edema and find that Barkan's case, published in 1919, is the only other instance on record of this condition associated with increased intraocular tension. They present a case in detail in which vision in one eye finally became lost and the eye was enucleated; two years later the second eye was similarly affected, with serious loss of vision. No form of treatment which they tried was of any avail. They suggest that the term allergic paroxysmal intraocular edema better designates this condition, inasmuch as it differentiates it from cyclitis and glaucoma. They refer to the case

reported by Bailliart in which there was edema of the conjunctiva which underwent variations parallel to those of glaucoma and to the 4 cases of allergic glaucoma reported by Kraupa. They point out that sometimes this condition can be confused with iridocyclitis associated with hypertension and sometimes with glaucoma associated with intraocular exudation. It is for this reason that the terminology is suggested.

S. B. Marlow.

Value of Hematologic Data in the Etiology of Ocular Diseases. I. M. Marcus, Vestnik oftal. **11**: 646, 1937.

Marcus records the blood findings in various ocular diseases which he studied for a number of years in the Ukrainian Institute of Ophthalmology. He observed 24 cases of interstitial keratitis, 53 of neuroretinitis, 31 of chorioretinitis and 26 of atrophy of the optic nerve. He stresses the differentiation between tuberculous (77 cases), malarial (55 cases) and syphilitic (87 cases) ocular diseases. Attention is paid chiefly (aside from lymphocytosis) to the leukocytic picture. The following conclusions were drawn:

1. The picture of the white and red blood cells and the number of thrombocytes are important from the point of view of the etiology of tuberculosis, malaria and syphilis of the eye.

2. The study of the blood picture aids in the differentiation of these three diseases. Tuberculosis of the eye is characterized by a prevalence of the chloranemic type of blood, normal polychromasia, a normal number of thrombocytes, frequently a normal number of reticulocytes, at times a leukocytosis, partial monocytosis, a normal number of eosinophils and at times an eosinophilia.

3. The blood picture is rather similar in both syphilitic and malarial ocular diseases. There are pathologic polychromasia, thrombopenia, at times a leukopenia and a shift of Schilling's curve to the right.

4. The differential points between malaria and syphilis of the eye are the following: In malaria there is a monocytosis with a normal number of eosinophils, while syphilitic conditions of the eye are characterized by monopenia and eosinophila.

O. Sitchevska.

Glaucoma

Research on Vascular Conditions in Cases of Glaucoma. G. Ciotola, Rassegna ital. d'ottal. **5**: 82 (Jan.-Feb.) 1936.

The author endeavored to determine the pathogenesis of glaucoma by the examination of the systemic circulation of 35 persons with primary glaucoma. Most of these patients had hypertension. The mean pressure also was much higher than normal but was not constant. The minimum pressure was always normal or below normal.

The venous pressure, determined according to Claude's method, was high in all cases. It was found to be an important objective sign in cases in which the vascular condition was altered.

As controls, the author examined 37 other patients with ocular diseases other than glaucoma and concluded that in cases of glaucoma

there was more alteration in pressure, usually an elevation, than in any other disease. The author considers this vascular change an important point in the probable pathogenesis of glaucoma.

A. PERZIA.

Injuries

OCULAR INJURY DUE TO A SPLINTER OF IRON: RECOVERY OF SPLINTER FROM THE LENS FORTY DAYS AFTER INJURY BY MEANS OF A MAGNET. A DEUTMAN, Klin. Monatsbl. f. Augenh. **100**: 444 (March) 1938.

A man consulted Deutman thirty-nine days after a splinter of iron entered the eye while hammering. The left eye was congested, and circumcorneal injection was present. Corresponding to a faint corneal scar, a small hole was observed in the iris which was adherent to the anterior capsule of the lens. The course taken by the splinter was visible by a localized linear opacity of the lens, terminating at the posterior capsule. The splinter could not be detected. Under traction of the giant magnet it appeared at the posterior surface of the iris, moved into the anterior chamber and then rested on the pupillary portion of the anterior capsule. It was removed with the hand magnet through a corneal incision made with the keratome. The lens remained clear with exception of the original opacity, and vision was fully recovered. After discussing the views of various authors, Deutman states that extraction should be attempted through the port of entrance at first, then in case of failure Elsching's method of removal should be used.

K. L. STOLL.

Lens

CONGENITAL FAMILIAL CATARACT WITH CHOLESTERIN DEPOSITS. M. RIAD BEY, Brit. J. Ophth. **22**: 745 (Dec.) 1938.

Bey presents an interesting pedigree of a family with familial congenital cataract associated with deposits of cholesterol crystals. The ages of the 13 members examined ranged between 6 and 85 years. Of this group, 7 females and 2 males were affected. There was no history of consanguinity in their parents nor of mental disturbances or convulsions.

The pedigree shows that the hereditary influence was strongly marked in the females and that the cataract was derived from an affected female by continuous descent in three generations.

No constitutional disease was found. There was no clinical evidence of hypoparathyroidism, hypothyroidism or myotonia atrophica. The presence of cataract and crystal formations was bilateral except in 1 patient, who lost her left eye early in childhood, probably the result of purulent ophthalmia. Owing to the similarity of the clinical appearance of the cataract in all the persons examined, one description seems to be adequate. With focal examination the cataract appeared to be composed of discrete or confluent, nearly circular, white or gray opacities, grouped toward the axial part of the lens in the position occupied by the suture lines. In some cases they extended deeply backward in the sub-

stance of the lens; in others, the opacities were tubelike, radiating forward and outward from the center. They terminated just short of the capsule of the lens. Numerous fine shining crystals scattered in the middle of these opacities could be focused. The peripheral part of the lens was clear.

The slit lamp microscope revealed that the space between the anterior capsule and the zone of disjunction was clear. In some cases the optical section of a narrow beam localized the opacities and crystals as extending deeply from the anterior to the posterior cortical zone. In others, it fell short of the posterior zone of the fetal nucleus.

With the broad beam, the opacities appeared either as flattened disks, more densely opaque at the periphery than at the center, or as a target of gray and white circles. A few others were mulberry-like and looked diaphanous when examined by transillumination.

The iridescent crystals were arranged at different angles and in different planes. A few appeared to be embedded in the masses of lenticular opacities. The crystals looked like tiny broken glass fragments; they were rectangular, with a notch at one corner, and were curiously transparent. They were optically indistinguishable from cholesterol crystals. Neither the opacities nor the crystals were to be seen in the periphery of the lens but only in the axial portion.

One illustration accompanies the article.

To the abstractor the cataracts described and the one shown in the illustration resemble coralliform cataract. Verhoeff found in his own case and in that of Zentmayer that the deposits were crystallized lens protein.

W. ZENTMAYER.

THE OCCURRENCE OF CRYSTALS IN THE CLEAR SENILE NUCLEUS OF THE LENS. E. PURTSCHER, Arch. f. Ophth. **139:** 358 (Sept.) 1938.

The author reports 7 cases in which the patients, all over 65 years of age, showed groups of glistening, needle-shaped crystals in the sclerosed but otherwise clear nucleus of their lenses. The chemical nature of these crystals is not definitely known. It has been suggested that they consist of cholesterol or other lipoid substances.

P. C. KRONFELD.

Neurology

OCULAR NEUROLOGY AND OTONEURO-OPHTHALMOLOGIC MOVEMENT. A. TOURNAY, Arch. d'opht. **1:** 289 (April) 1937.

Tournay reviews the history of the relation between otology, neurology and ophthalmology of the last fifteen years and points out that especially since the World War centers have been created where specialists in these branches of medicine are working together. He recalls that André-Thomas some time ago suggested the necessity of breaking down the dividing lines between these specialties for the advancement of all. He shows that considerable work has been done along this line and discusses the subject in relation to the cerebrospinal system, the vegetative nervous system and the circulatory apparatus, which includes the cerebrospinal fluid and the blood supply. He believes that

in order that this work should go on the nomenclature should be revised, simplified and made similar. The necessity for cooperation if the proper advancement is to be made is emphasized.

S. B. MARLOW.

ARACHNOIDITIS WITH ATROPHY OF THE OPTIC NERVE: REPORT OF A CASE IN WHICH OPERATION WAS PERFORMED. C. CLIVIO, Riv. oto-neuro-oftal. **15:** 104 (March-April) 1938.

Clivio reports a case of arachnoiditis of the chiasma in which operation was done very late. A good surgical result was obtained but no improvement in vision. As there was already atrophy of the optic nerve at the first preoperative examination, this case is presented to emphasize the necessity for earlier operation.

F. P. GUIDA.

TOTAL UNILATERAL OPHTHALMOPLEGIA: CLINICAL CONSIDERATIONS OF A CASE. V. TRONCONI, Riv. oto-neuro-oftal. **15:** 168 (March-April) 1938.

Tronconi attempts to differentiate clinically between the syndrome of a lesion of the medial portion of the superior orbital fissure or a syndrome of the circle of Zinn and other syndromes of this area.

Hypothetically, Tronconi thinks that an inflammatory lesion localized in the intra-annular portion of the ophthalmic vein (periphlebitis) might give rise to clinical symptoms limited to the region of the circle of Zinn.

F. P. GUIDA.

Orbit, Eyeball and Accessory Sinuses

ORBITAL INFLAMMATION. F. CARAMAZZA, Riv. oto-neuro-oftal. **15:** 1 (Jan.-Feb.) 1938.

Caramazza describes 12 cases of orbital lesions, 9 of which were of an inflammatory nature.

Two types of inflammatory lesions can be differentiated: a circumscribed type which gives rise to a suppurating cavity and has a much less grave prognosis than the second type and a diffuse type which produces a rapidly invasive necrosis of the tissues.

On the first day of the diffuse inflammatory lesion the local and general clinical signs are marked. The general condition is serious, as the character of the disease is that of a septicemia, with an elevated temperature; locally there is a rapidly increasing edema. Usually on the second day the edema is not limited to the lids but extends to all the orbital tissues. The ocular bulb becomes compressed, and a disturbance of nutrition takes place; the cornea becomes so edematous that it is impossible to see the iris, and the conjunctiva is chemotic and becomes lardaceous. The general and local symptoms rapidly become more marked; the tissues of the lids, the conjunctiva and the orbital contents become necrotic, and death usually follows in this form by pyemia, septicemia or intracranial extension.

Circumscribed inflammation gives rise to the rapid formation of an abscess, and although one cannot exclude the possibility of a fatal out-

come, generally a more favorable prognosis can be given. Often one may succeed in saving the globe and occasionally visual function.

In both types bony lesions of an osteomyelitic character may result.

In all cases of inflammation of sinus origin Caramazza observed the presence of infection of a maxilliary sinus, either alone or in conjunction with infection of other sinuses. Also, the most serious orbital infections were always accompanied by maxillary sinusitis.

Therapeutically, the author feels that early cleansing of the orbit and the surrounding infected sinuses should be done.

In 1 case of severe diffuse inflammation with gas gangrene Caramazza obtained immediate cessation of the symptoms, both local and general, on exenteration of the orbit and treatment of maxillary sinusitis of dental origin. The result was unusual, as doubtlessly the outcome is always fatal. Caramazza feels that in all cases of severe involvement a systematic surgical cleansing of the orbit and sinuses should be done. This is true, of course, only of cases of severe involvement, but the cleansing should be done early enough to avoid all intracranial extension.

Twenty-seven photographs and diagrams accompany the article.

F. P. GUIDA.

Physiology

THE CONCEPT AND THE SIGNIFICANCE OF PHOTIC DARKNESS. J. VAN ESSEN, Arch. f. Ophth. 139: 105 (Aug.) 1938.

Darkness signifies the impossibility of visual discrimination or the impossibility of orientation in space by means of the eye. Darkness thus becomes the experience of diffuse vision but is not identical with not seeing or with seeing black. The sensation of black is the aphotic form of darkness, in addition to which there is white or colored, that is, photic darkness. In man photic darkness is experimentally shown to be a definite form of visual experience. In certain lower animals and in plants photic darkness is the only visual sensation ever experienced. The organs of sense which convey the sensation of photic darkness in these lower animals should be called organs of light and thus be distinguished from the organs of sight of higher animals.

P. C. KRONFELD.

Retina and Optic Nerve

WITHDRAWAL OF INTER-RETINAL FLUID IN DETACHMENT OPERATION BY SIMPLE SUCTION APPARATUS. C. J. BLUMENTHAL, Brit. J. Ophth. 22: 542 (Sept.) 1938.

The apparatus described in this article was devised to facilitate the removal of the inter-retinal fluid during operations for retinal detachment. It consists of a glass tube with a suction cup at one end, set at the requisite angle, the other end carrying a length of soft rubber tubing. A small plug of loose cotton wool may be packed into the distal end of the glass tube in order to prevent the possibility of a flow of organisms, either air or fluid, being borne toward the operative area. Suction is produced by the mouth of the operator. When the pressure inside

the soft tubing is sufficiently reduced, its walls collapse, a simple safeguard against obtaining too high a negative pressure.

The article contains one illustration.

W. ZENTMAYER.

ANATOMIC INTRACRANIAL LESIONS IN RETROBULBAR NEURITIS. G. SOURDILLE, Arch. d'opht. 1: 3 (Jan.) 1937.

After reporting 25 cases of retrobulbar neuritis in which internasal operation was performed, the author discusses in some detail the anatomic relation of the optic nerves to the sinuses and the meninges. He feels that this relation is important in the causation of retrobulbar neuritis in some cases and suggests that surgical treatment is imperative (1) in all cases of optic neuritis, even when recent, important malformations of the nose are present; (2) in cases in which there is no apparent nasal lesion but the symptoms of the neuritis show characteristics which can be interpreted as being due to arachnoiditis, and, in addition, (3) in cases in which the patient does not improve in spite of medical treatment. The author emphasizes the nonspecific character of this surgical procedure. In his opinion a definite etiologic factor, such as multiple sclerosis or syphilis, is not a contraindication to operation if the medical treatment seems to be without effect.

S. B. MARLOW.

RETINAL HEMORRHAGES IN ASSOCIATION WITH MENINGEAL HEMORRHAGE OF THE NEWBORN. G. RENARD, Arch. d'opht. 1: 30 (Jan.) 1937.

Retinal hemorrhages are found in about one third to one half of the newborn with pachymeningitis. The author thinks that the hemorrhages are frequently due to a mechanical factor related to increased intracranial pressure. However, early flame-shaped hemorrhages unaccompanied by papilledema must always be looked for, for they have a great diagnostic value. They probably indicate a congenital vascular change, perhaps due to hereditary syphilis.

S. B. MARLOW.

DETACHMENT OF THE RETINA OF MACULAR ORIGIN AND ITS SURGICAL TREATMENT. M. SOBHY-BEY, Arch. d'opht. 1: 40 (Jan.) 1937.

The author describes 6 cases of detachment of the retina in the macular area in which he was able to use diathermic coagulation successfully. He points out that the diagnosis of detchment in its early stages is difficult but that if a strong source of light is employed it is possible. Five of the 6 patients were past 40 years of age, and of the 5 operated on, 4 obtained successful results. The author believes that the previously unfavorable prognosis is now changed. There was distinct improvement in the vision in the cases cited.

S. B. MARLOW.

VARICOSITIES OF THE PAPILLA. E. AUBARET and G. FARNARIER, Arch. d'opht. 1: 304 (April) 1937.

The authors point out that vascular anomalies of the fundus of the eye have been known for a long time but still remain a clinical curiosity. They describe an unusual case in which they feel that an obstruction behind the papilla along the course of the optic nerve resulted in the varicosity that followed. They refer to the case reported by Knapp in 1910 and by Landolt in 1911 and to further observations of Fuchs, Sammelsohn and Jacobi in which the same pathogenesis was hypothecated. This case is described at some length. Most of the other reports have dealt with congenital malformations or with venous changes associated with retinal arteriosclerosis.

S. B. MARLOW.

TRAUMATIC LESION OF THE OPTIC NERVE. G. BELLONI, Riv. oto-neuro-oftal. 14: 521 (Nov.-Dec.) 1937.

Belloni describes and discusses a case of immediate blindness following trauma to the temporoparietal region. At autopsy seven days later a break in the continuity of the nerve fibers of the inferior half of the optic nerve was found. No evidence of fracture of the bony walls of the canal or extravasations of blood could be found.

F. P. GUIDA.

A HITHERTO UNKNOWN HEREDITARY OCULAR DISEASE (DEGENERATIO HYALOIDEA-RETINALIS HEREDITARIA) OBSERVED IN THE CANTON OF ZURICH: REPORT OF CASES. H. WAGNER, Klin. Monatsbl. f. Augenh. 100: 840 (June) 1938.

Wagner reports the observation of a new ocular disease in 13 of 26 members of one family from 1934 on. A genealogy comprising 3 generations is appended. The disease originates in the retina and vitreous, appears to be congenital and offers no ophthalmoscopic evidence of inflammation. The following characteristic symptoms were found: The vitreous was optically clear, showing only a few isolated floating cords; a peculiar preretinal circular membrane in the equatorial section of the vitreous was noted in every patient. At the first glance it resembled a detached retina. Holes were observed in the membrane, which was well defined toward the periphery in some cases or extended into the ora serrata, without demarcation, in others. In some instances the membrane, presenting a circular arrangement, was connected with the internal limiting membrane of the retina; it varied in size and protruded into the vitreous. The retinal vessels, especially the veins, were thin, and some were surrounded by white sheaths. Isolated pigment dots were observed in the periphery of the retina. Atrophy and sclerosis of the vessels occurred. Some of the patients presented a pale, yellowish disk, and 1 of them presented complete white atrophy of the optic nerve. All of the patients were myopic, with myopic astigmatism of the cornea. Concentric contraction of the field of vision and reduced visual acuity were common to every patient; these changes increased later due to lenticular opacities. Various degrees of reduced adaptation to dark were noted. All the patients, except the youngest, had peculiar opacities

of the posterior cortex of the lens, accompanied by nuclear cataracts later. Because of synchysis of the vitreous extraction of the cataracts was not advisable. Blindness may follow atrophy of the optic nerve in middle age. There were no cerebral disturbances. The youngest generation presented the largest number of sufferers from this disease; an equal portion of the other two generations was afflicted or healthy, respectively. The disease is dominantly hereditary in the mendelian sense. Wagner is of the opinion that the spread of this disease should be preventable.

K. L. STOLL.

Tumors

RECURRENT EPITHELIOMA OF THE LIMBUS WITH SHARPLY SEPARATED, LARGE PALPABLE CORNEAL BASES. JEAN SÉDAN, Ann. d'ocul. **175:** 829 (Nov.) 1938.

In 1928 the author saw a patient with epithelioma of the cornea; ten years later the patient presented himself with a recurrence.

This tumor was the subject of a former communication. For nearly a year before seeking a physician the patient had had a tumor of the limbus of the left eye and with it an acute and extremely painful iritis. The iritis was so unpleasant that little importance was paid to the small ocular tumor. Removal of the growth with clearing of the cornea caused a rapid cure of the iritis, which up to that time had resisted treatment with atropine and ethylmorphine hydrochloride as well as general treatment. In the former report the histologic structure of the growth was described in detail.

The patient was not seen again until the end of January 1936, when he was found to have a large recurrent tumor mass. Because of the position of the growth and the curious extreme adhesions, it was thought that it would be of interest to report the case a second time. The appearance of the tumor was similar to that of the original growth seen in 1928. The feature that was most singular was the double adherence of the tumor mass to the cornea between 11 and 7 o'clock on one side and to the palpable conjunctiva on the other.

Two illustrations and a bibliography accompany the article.

S. H. MCKEE.

Uvea

TRICHLOROACETIC ACID IN THE TREATMENT OF IRIS PROLAPSE. J. W. BETTMAN and H. BARKAN, Am. J. Ophth. **20:** 131 (Feb.) 1937.

Bettman and Barkan cite the type of prolapse of the iris suited to treatment with trichloroacetic acid and its advantages over actual cautery. They give 5 case reports and draw the following conclusion:

"Trichloroacetic acid is of very definite value in the treatment of certain types of iris prolapse. In the proper cases it produces results which cannot be equaled by other methods of treatment, and we believe it deserves more general use."

W. S. REESE.

Sympathetic Ophthalmia

SYMPATHETIC OPHTHALMIA. D. H. TROWBRIDGE JR., Am. J. Ophth. 20: 135 (Feb.) 1937.

Trowbridge draws the following conclusions after a detailed study of 32 cases of sympathetic ophthalmia:

"1. Sympathetic ophthalmia does occur, and not rarely, in persons over sixty years of age. 2. Perforating injuries and outbreak of sympathetic ophthalmia were twice as frequent during the period between October and April as between May and September. 3. Sympathetic ophthalmia may follow nonperforating injuries, and may develop in the absence of trauma when a necrotic intraocular tumor is present. 4. A soft, shrinking exciting eye with greatly impaired (or totally lost) vision is usually found at the time of outbreak of inflammation in the fellow eye, the vision of which may not be impaired. 5. Perforating wounds in the cornea or at the limbus are no less dangerous than wounds in the ciliary body from the standpoint of sympathetic ophthalmia. Especially liable to result in sympathetic inflammation are eyes with unhealed wounds in any region. 6. While the interval between injury and outbreak does not seem to be an important factor in the outcome of the secondarily affected eye, a protracted interval between the onset of sympathetic inflammation and removal of the exciting eye affects unfavorably the outcome in the fellow eye. By the same token, enucleation of the exciting eye affects favorably the prognosis for the other. 7. Photophobia, lacrimation, ciliary injection, cells in the aqueous, and deposits on the posterior corneal surface or on the anterior lens capsule, these, frequently accompanied by some visual impairment, are among the most common early findings in the sympathizing eyes. But neuroretinitis in the uninjured eye may be the earliest sign of an impending sympathetic inflammation, and a sudden increase in refraction may precede more definite signs of inflammation in the sympathizing eye by as much as five days. 8. Sympathetic ophthalmia may develop following iridencleisis and may develop in the presence of panophthalmitis. 9. While the extent of the specific infiltrate surrounding the scleral emissaries is not of great prognostic significance, evisceration of the contents of the globe probably does not protect against transfer of sympathetic uveitis to the fellow eye. Even when enucleation is performed it is probably wise to remove as much of the optic nerve and extraocular tissues attached to the globe as is feasible. 10. The prognosis in the case of the sympathizing eye cannot be safely based upon the extent or location of the specific infiltrate in the exciting eye. 11. Phagocytosis of pigment by the epithelioid cells of the infiltrate occurs in some degree in sympathetic ophthalmia, but the Fuchs-Dalen nodule is not necessarily the site of this activity. 12. The extent of pigment phagocytosis or of change in the retinal pigment epithelium in the exciting eye does not affect the prognosis for the sympathizing eye. 13. Eosinophiles and plasmacytoid cells may compose part of the infiltrate in sympathetic ophthalmia. 14. Removal of foci of infection and ultraviolet irradiation of the body may offer valuable means of combating sympathetic ophthalmia."

W. S. REESE.

Society Transactions

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NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

JAMES W. WHITE, M.D., *Chairman*

Feb. 20, 1939

RUDOLF AEBLI, M.D., *Secretary*

CONTACT GLASSES FOR CORRECTION OF REFRACTIVE ERRORS IN MONOCULAR APHAKIA: PRODUCTION OF BINOCULAR SINGLE VISION. DR. ARNO E. TOWN.

This article appeared in full, with discussion, in the June issue of the ARCHIVES, p. 1021.

ABSORPTION LINES OF THE CORNEA. DR. JOSEPH LAVAL.

This article will be published in full, with discussion, in a later issue of the ARCHIVES.

SUBCONJUNCTIVAL INJECTIONS OF NEOPRONTOSIL IN THE TREATMENT OF OCULAR INFECTIONS. DR. R. TOWNLEY PATON.

This article will be published in full, with discussion, in a later issue of the ARCHIVES.

ALTITUDINAL HEMIANOPIA ASSOCIATED WITH BILATERAL ABSENCE OF THE RADIAL PULSE: REPORT OF A CASE. DR. HAROLD W. BROWN.

The important features in this case are: complete hemianopia of the lower right field, first recognized by the patient nine months ago, during neurologic examination; pallor of the right disk limited to the upper half; reduction of central vision from 20/15 in each eye in 1935 to 20/60 in the right eye and 20/200 in the left eye at the time of this report; bilateral absence of the radial pulse and nonobtainable blood pressure from either arm, first discovered at a medical examination four years ago, and no conclusive neurologic signs. Roentgenograms of the skull showed the sella turcica, orbits, optic foramens, chest and sinuses to be essentially normal. The Wassermann reactions of the blood and spinal fluid were negative.

The patient (Mrs. A. S., white, aged 41, a housewife) was first examined at the ophthalmic clinic of the New York Post-Graduate Medical School and Hospital in June 1935. She complained of blurring of vision and dizzy spells for two months. Attacks came on two or three times a day and lasted only a few minutes. Vision was noted as 20/15 in each eye. There were a slight conjunctivitis and a few small corneal

nebulae near the limbus, resulting from corneal ulcers five years previously. The patient gave no history of other ocular diseases or injury. The lens, media and fundi were reported to be normal, and the patient was referred to the medical clinic.

The patient felt better for the next few months and did not report to the medical clinic until September 1935. Absence of the radial pulse was noted, and she was admitted to the hospital for medical and vascular examination.

The patient was 5 feet and 1¼ inches (155.6 cm.) in height; her weight was 95 pounds (43.1 Kg.), and had been constant for the past three years. The blood pressure could not be obtained from the arms, but that taken from the legs varied, even on the same day, from 144 systolic and 98 diastolic to 170 systolic and 110 diastolic. The pulse rate in the ankle was 110. The electrocardiogram was normal, except for indications of simple tachycardia. The urine was normal. Examination of the blood revealed the presence of slight anemia, a hemoglobin content of 79 per cent and 3,620,000 red cells. The Wassermann reaction was negative, and the blood chemistry was within normal limits. The basal metabolic rate was —1. The Allen test demonstrated normal circulation for the radial and ulnar arteries. Roentgenograms of the chest, head and sella turcica showed no important positive findings.

The patient had always been in good health and had had no major illness or operations. During seven years of marriage there had been no pregnancies.

The family history was essentially irrelevant. The patient's father, aged 60, was living and well. Her mother died at the age of 36 of acute gastritis. Two brothers, aged 32 and 36, were living and well. One sister died at the age of 5 of scarlet fever. There was no history of a major ocular disease or of a nervous or mental disorder on the mother's or the father's side.

The patient was discharged from the hospital with a diagnosis of anomalies of the arteries of the neck (congenital) with stenosis, particularly of the subclavian arteries. She was followed in the medical clinic until January 1938, with no important changes in the physical findings except for increasing complaints of dizzy spells and blurring of vision.

On her next visit to the eye clinic on Dec. 6, 1938, she complained of loss of vision of the lower half of the right eye. She stated that she was examined by Dr. Troncoso in May 1937 and was told that she had lost the central vision of the left eye but had good vision in the right eye.

For two days in March 1938 she noticed diffusion of reflected light in the right eye, as if some fluid had gotten in the eye and was reflecting the light, followed by some difficulty in judging her steps while looking down. On the advice of her physician, she was admitted to the neurologic service of the Bellevue Hospital. She was first conscious of the defect in the right field when a routine test was made of the visual fields. According to the report from the hospital vision in the right eye was 20/60 and in the left eye 20/200, and there was complete loss of the lower half of the right visual field, with a central scotoma for colors in each eye. There was also a temporal scotoma for colors in each eye. The neurologic examination gave no definite diagnostic information.

Tests of the visual fields at the ophthalmic clinic of the New York Post-Graduate Medical School and Hospital in February 1939 showed

no change from those taken at the Bellevue Hospital, and the vision remained the same (20/60 in the right eye and 20/200 in the left eye). When the patient held her head down a little, the vision improved somewhat. The right pupil was slightly larger than the left, but regular, and reacted to light and in accommodation. Muscle balance, intraocular tension and exophthalmometer readings were normal. The fundus of the right eye showed pallor limited to the upper half of the right disk. The arteries were normal, and the veins were engorged and tortuous, with no evidence of a retinal pathologic process.

Neurologic examination by Dr. Blakeslee on Feb. 13, 1939, gave negative results, except for the ocular findings, hyperactive patellar reflexes and easy fatigability of the abdominal reflexes.

DISCUSSION

DR. RALPH I. LLOYD: I saw this patient at the Bellevue Hospital last spring and mapped her fields of vision. The field of the left eye showed typical altitudinal hemianopia with the functioning area above the horizontal meridian. The field of the other eye was similar, but the hemianopia was not so far advanced. The vision was poor in each eye. Dr. Brown asks me to tell the cause, but I cannot. In my opinion, the lesion is at the chiasm, as similar defects of the visual fields occur in cases of syphilitic chiasmal arachnoiditis. Specific types are more common; some of them have been seen at operation and some at autopsy. Membranes have been found shrouding the chiasmal region and sometimes have extended far back, to the region of the roof of the fourth ventricle.

Another condition in which somewhat similar defects occur has been well studied. The elder Fuchs conducted a series of autopsies on elderly patients and demonstrated the pernicious effect of pressure of sclerosed vessels of the circle of Willis on the chiasm and its contributing parts. The posterior communicating arteries may damage the tracts just before they enter the chiasm and the carotid artery at the lateral angle. The most serious damage was usually encountered where the ophthalmic artery pressed the optic nerve against the sharp edge of the dura at the entrance of the optic canal, sometimes making a marked indentation in the optic nerve.

The defects of the visual fields in the present case are one of two commonly found types. The first type begins with a marked contraction of the peripheral field associated with a cecocentral scotoma, which has the blindspot at one end and the fixing point at the other. The next step is the breaking through of the central scotoma to the periphery, and this shows on the chart more often below than above. This makes a somewhat U-shaped functioning field, with the opening above or below, according to the location of the breaking through. The vertical portions then disappear, and all that is left of the functioning field is the transverse portion. This functioning remnant is usually just above the horizontal meridian, as in the present case. The macular area is seriously damaged early in the process. The other type consists of an irregular contraction of the field, beginning usually in one eye as a sector defect and advancing steadily, the vision being affected early. The second eye is affected later, the contraction beginning in the peripheral field,

which is considered as evidence that the lesion has affected one optic nerve near the chiasm and later spread thereto. This type is subject to wider variation than the first. The rate of progress in syphilitic chiasmal arachnoiditis may be very rapid or very slow. The field outlines in the cases of rapid extension are usually those of bitemporal hemianopia or one of its variations, while the process in the cases in which extension is slower resembles typical syphilitic atrophy of the optic nerve. Behr has demonstrated at autopsy that sclerosed portions of the circle of Willis may seriously damage parts of the chiasm by direct pressure. If the field outlines change frequently, one should think of aneurysm, but the diagnosis cannot be made in advance of the inevitable rupture.

It would seem reasonable to place this particular case in the group in which the condition is caused by direct pressure of sclerosed vessels on some part of the chiasm.

Dr. Percy Fridenberg: Attention was called to the pallor of the upper half of the disk. I should like to ask if any examination was made by red-free light to show atrophic changes in the optic nerve fibers corresponding to that pallor. It would be interesting to know if there is macular degeneration in the eye, but examination with red-free light would show whether there is a terminal lesion in the nerve fiber.

Dr. Kaufman Schlivek: If a careful encephalographic study is made in this case it may help in the diagnosis. Every one has seen cases in which it is almost impossible to make a diagnosis, and all these conjectural diagnoses will be of no avail unless one rules out the possibility of tumor. I think that the only way to do this would be to make an encephalogram.

Dr. Henry Minsky: The case as presented brings to my mind one possibility as being quite real. A condition characterized by remissions, defects in the visual fields, increased reflexes in the lower extremities and a fatigability of the abdominal reflexes suggests to me the picture of multiple sclerosis.

Relation of Vascular Disease to Retinitis: A New Clinicopathologic Study. Dr. S. A. Agatston.

Retinitis, as it is called, is a disease involving the anterior layers of the retina, manifested by the presence of exudates and hemorrhages. While it is accepted that there may be an inflammatory process in the form of chorioretinitis, the term retinitis, as commonly applied, is a misnomer.

Not only is retinitis not inflammatory, but the changes in the retina are definitely dependent on pathologic changes in the blood vessels or an abnormal composition of the blood or on both. In other words, retinitis is not a disease of the retina but a manifestation of disease elsewhere.

Since a break in the continuity of retinal arteries has never been demonstrated, it would be most logical to concentrate on a pathologic change in the veins and capillaries as the probable direct cause of retinopathy.

With a view of correlating ophthalmoscopic, clinical and postmortem observations, work was undertaken with the collaboration of Dr. Howard Agatston in the laboratory of the Montefiore Hospital.

The following are the postulates on which the study is based:

1. Since a person past the age of 80 years usually shows normal retinal arteries, it is assumed that primary, nonhypertensive sclerosis is evidence of generalized arteriolar sclerosis, which indicates a pathologic rather than a physiologic aging process. Angiospastic phenomena may be superimposed on primary sclerosis in some cases, causing hypertension.

2. In nonhypertensive sclerosis the retinal veins show changes similar to those found in the arteries. This is evidenced by irregular caliber, tendency to engorgement and thrombosis.

3. In so-called hypertensive sclerosis, or angiospastic arteriolar disease, the important pathologic phenomenon is primarily a spasm, followed by changes found at the location of the spasm and distal to it, which are secondary to the occlusion. Retinal veins and capillaries are not affected until late in the disease.

4. Any form of occlusion, such as is induced by pressure of retrobulbar neuritis, papilledema, edema of severe chorioretinal inflammation or glaucoma, causes pathologic changes similar to those caused by hypertensive sclerosis in some or in all of the branches.

5. In essential, or early malignant, hypertension retinal hemorrhages and exudates are usually absent. In glomerular nephritis early appearance of exudates is simultaneous with reduced renal function and albuminuria. The exudates are evidently the outcome of increased permeability of capillaries to protein with a subsequent breaking down of the capillary walls. The arterial picture is that of early hypertension rather than of advanced essential, or malignant, hypertension. The same holds good for the toxemia of pregnancy, in which renal dysfunction is probably created by pressure on the renal vessels.

Even in chronic glomerular nephritis with hypertension the retinal arteries show relatively good caliber.

In nephrosclerosis, however, which is the terminal stage of essential and of malignant hypertension, neuroretinitis is characterized by a marked attenuation of the vessels, frequently to the degree of quasi-invisibility. In a small percentage of cases a nephrotic stage is encountered, the patients generally giving a history of an antecedent attack of glomerular nephritis. These patients show profuse albuminuria, anasarca and moderate hypertension but no active arteriolar changes in the fundi. It would appear that the arteriolar system is quiescent in this group.

6. It is assumed that in diabetes changes in the veins and capillaries may exist even in the absence of arteriolar sclerosis. This was postulated because of frequency of hemorrhage and diabetic retinitis in the presence of relatively normal arteries; also, if even moderate hypertension is coexistent with diabetes, hemorrhages and exudates appear in spite of normal renal function. Moreover, advanced nonhypertensive sclerosis is definitely known not to cause retinitis.

It may be safely promised that large hemorrhages are caused by thrombosis of the veins and venules, while small hemorrhages are the result of leaking capillaries.

Experimentally, histamine will produce a contraction of the arteriole followed by dilatation of the capillaries. Other H substances have a depressor effect on the capillaries, causing dilatation.

Increased permeability to protein is brought about by dilatation of the capillaries, particularly when with fewer red blood cells the oxygen content is reduced.

Hyalinization and necrosis of capillary walls are probably responsible for small hemorrhages. I am inclined to believe that in hypertensive sclerosis, dilatation following spasm is responsible for increased permeability in the presence of renal toxemia, whereas permeability of capillaries in diabetes is due to early structural changes in the capillary walls. All ophthalmologists are familiar with the fact that even when the patient under treatment is free from sugar, fresh retinal hemorrhages continue to appear. On the other hand, some persons with diabetes do not show any hemorrhages.

Moritz and Oldt stated that changes which are found in the intima and media of arterioles may be caused by high blood pressure, but that there is no definite proof of this. Careful ophthalmoscopic examination of the blood vessels, however, shows that the cause of hypertension is the cause of sclerosis. The very fact, brought out by ophthalmoscopic examination, that any form of blocking of the artery, even in the absence of general disease, produces changes which are identical with those of hypertension, is a strong indication that the sclerosis of hypertension is caused by spastic blocking. Furthermore, these changes are limited to the branches that have been subject to spasm. This logically explains the nonuniformity of the sclerotic changes. Evidently cutting off the blood supply by spasm is the direct cause of hyalinization and other signs of sclerosis. From this one can infer that the intimal hyalinization observed in nonhypertensive arteriolar sclerosis is secondary to generalized nutritional disturbance.

In aiming to demonstrate our correlation between ophthalmoscopic changes and postmortem observations, we have, so far, collected specimens of retinas from 60 patients who have been studied clinically and ophthalmoscopically as well as at autopsy. In order to get longitudinal sections of the vessels and bring out clearly the capillary network, we made tangent and oblique sections instead of cross sections. By this method the vascular system is unfolded and can be studied in great detail. Changes which could not be observed by other methods of sectioning were easily recognized. Arteries were differentiated from veins without any difficulty. Capillary network which is prominent in the internal nuclear layer stands out in relief.

Unilateral Lacrimation and Hydrorrhea Associated with Chewing. Dr. Philip Adalman.

A white man 73 years of age was observed to have unilateral lacrimation and hydrorrhea associated with chewing. He also complained of pain over his left eye, extending upward and backward over the frontal area. The condition had existed for over twenty years, with questionable remissions.

The symptom complex would appear also under other conditions; as for example when the patient would rub the left side of his nose, wash

his face with either hot or cold water, drink hot beverages, taste hot spices, be exposed to drafts of air, bend his head downward or read very small print.

The patient stated that before or about the time of the onset of these symptoms he experienced attacks of severe sharp "dancing" pains over the entire left side of his face and particularly over his forehead. For many years he had noticed a progressive diminution of auditory acuity, particularly in his left ear. Five years after the onset of the ocular condition he had an episode consisting of drowsiness, dizziness, retention of urine and weakness in the extremities. He was hospitalized for this condition, which lasted three weeks. There was no history of injury or operation.

The vision in the right eye was 20/50; with correction it was 20/30. Vision in the left eye was 20/40; with correction, it was 20/30. Chronic blepharitis was present in each eye. The right pupil measured 2 mm. and the left 3 mm. The palpebral fissure in the right eye measured 8 mm. and in the left eye 11 mm. During the active phase of the symptoms they measured 8 mm. and 13 mm., respectively. The puncta lacrimalia dipped normally into the lacus lacrimalis. The lacrimal passages irrigated freely. The neck of the left lacrimal duct felt definitely spastic to a no. 1 Bowman's probe as compared with the right. There was marked injection of the conjunctival vessels with lacrimation and pain in the distribution of the first division of the left trigeminus nerve under the following conditions: (1) when the patient chewed vigorously; (2) when there was pressure on the anterior part of the superior gum, just lateral to the midline; (3) when the left nostril was rubbed; (4) when the patient blew his nose; (5) when he tasted hot spices; (6) when electrical stimulation was applied to the left side of the forehead; (7) when deep pressure was applied to the left cheek sufficient to cause pain, and (8) when the patient read small print. The left corneal reflex was diminished. There was diminished sensation for pain, temperature and touch in all three divisions of the left trigeminus nerve. The left eyeball was slightly more prominent than the right, especially during the active phase. The exophthalmometer readings during the quiet phase were: right eye, 22 mm.; left eye, 23 mm. These findings are suggestive of hyperactivity of the cervical sympathetic nerves.

The neurologic examination was done by Dr. M. B. Bender, who reported in addition to the aforementioned symptoms: (1) absence of the ankle jerks bilaterally, (2) a positive Babinski sign on each side and (3) diminution of the vibratory sense in both lower extremities. The Wassermann reaction of the blood was negative. The blood pressure was 170 systolic and 100 diastolic. The heart was somewhat enlarged, with evidence of arteriosclerosis. The deafness was of the conduction type.

The clinical picture would present itself within a few seconds after the patient began the act of chewing. At the onset he experienced sharp "dancing" pains, beginning in the eye and extending upward to the brow and then radiating to the frontal region to terminate at the top of the head. During this time one could see the margins of the left eye becoming acutely congested. There was an accumulation of tears in the cul-de-sac which soon spilled over onto the cheek. Concomitantly, there was a watery flow from the left nostril.

So far as I am able to learn there has been no mention of this interesting symptom complex in either the American or the German literature.

In considering the etiology, the possibility of some pathologic process in the glenoid fossa of the temporomandibular joint which could set up a mechanical irritation of the auriculotemporal nerve was not considered. Such lesions have been reported in cases of faulty occlusion of teeth or artificial dentures. However, in the present case roentgen examination of both joints gave negative results.

The clinical picture is difficult to diagnose, but it may possibly be explained on the basis of a cerebral lesion dating back from the time of the neurologic episode, which occurred about fifteen years previously. There is obvious involvement of all branches of the trigeminus nerve, with the motor division initiating the syndrome during the act of chewing, the hydrorrhea being caused by stimulation of the nasociliary branch of the first division.

DISCUSSION

DR. MORRIS B. BENDER: This interesting condition seems to be associated with a disturbance in the left trigeminus nerve, that is, either neuritis or neuralgia.

There is no doubt that the patient has a disease of the nervous system and that the left fifth cranial nerve is definitely involved. The clinical course of the disease is suggestive of a recurring inflammatory process. In one attack there may have been neuritis of the left trigeminus nerve, and probably many of the nerve fibers became degenerated. During the process of repair the regenerated fibers branched and grew in all directions, losing their original anatomic arrangement. Under such conditions an impulse meant for one group of structures would spread by diffusion, facilitation and axon reflexes to other structures. The result would be a diffuse effect, as in this case. Whenever this patient attempted to innervate the muscles of mastication, impulses spread to the ophthalmic division, causing formation of tears and sensation of "dancing" pains. This is analogous to (1) the crocodile tear syndrome due to lesion of the facial nerve involving the geniculate ganglion, (2) the auriculotemporal syndrome, (3) the synkinesias following Bell's palsy and (4) the pseudo Graefe phenomenon.

The other possibility is that this patient has neuralgia of the trigeminus nerve. When the ophthalmic division is involved there are lacrimation and congestion of the conjunctiva, as seen in this case. There are trigger points such as this patient seems to have, that is, over the nostril, gums, forehead and face. The chief objection to a diagnosis of neuralgia of the trigeminus nerve, however, is that there is definite evidence of disease of this nerve, that is, sensory changes in the face and loss of corneal reflex. These signs indicate an involvement of the trigeminus nerve and therefore take the condition out of the category of neuralgia.

I believe that this patient's symptoms are due to neuritis of the trigeminus, whatever the mechanism may be.

DR. LEON WEISS: I have seen a similar case of lacrimation and hydrorrhea associated with the act of chewing. In both patients the main symptoms, namely, the lacrimation and the salivation, were parasympathetic phenomena. Therefore, I believe that the picture is mainly

due to stimulation of the parasympathetic fibers of the third, seventh and ninth cranial nerves. The evaluation of the part played by the sympathetic division of the autonomic nervous system, if any, can best be determined by blocking the cervical sympathetic chain with procaine hydrochloride.

HERPES ZOSTER OPHTHALMICUS: REPORT OF A CASE. DR. FRANCIS RICHMAN.

I employed injections of diphtheria antitoxin in the treatment of a patient with herpes zoster ophthalmicus, thus confirming the efficacy of the treatment described by Walker and Walker in the August 1938 issue of the ARCHIVES, page 305.

The patient, a white man aged 46, had been in good health up to the time of the present illness. On examination of the eyes a short time before there had been no ocular pathologic process.

The present illness of six days' duration followed a five hour drive in freezing weather with the car window lowered a few inches from the top. As the patient drove, he felt the constant impact of the freezing air on his left eye and the left side of his head. The eruption appeared soon after; it grew worse in spite of local treatment by the family physician.

At examination, he showed a typical herpes zoster ophthalmicus on the left side, extending from the crown of the head to the upper lid. The severest lesions involved the eyebrow, the inner canthus along the entire margin of the upper lid and the outer canthus. The lids were shut tight due to the edema and swelling; there was swelling of the entire half of the face and jaw; the preauricular and postauricular glands and the entire chain of anterior cervical lymph nodes were enlarged and sensitive. The cornea was not involved at any time, nor was its sensitivity affected. Subjectively, the pains complained of were typical and "unbearable."

Abatement of subjective and objective symptoms began immediately following the intramuscular injection of 5,000 units of diphtheria antitoxin. Another injection of like amount was given forty-eight hours later. Ergophene ointment (a combination of ergot and phenol in a zince oxide ointment base) was applied locally, and a daily exposure to short wave radiation was given to hasten drying of the vesicles. Progressive improvement took place, and the patient was discharged from the hospital on the eighth day. On the day of discharge a generalized reaction developed in the form of hives, probably due to the injections of serum. These disappeared five days later, the skin and glands showed a complete recession of involvement, and all subjective symptoms completely disappeared. At the time of this report the left eye is normal throughout, and vision is 20/20. The entire duration of the illness was three weeks, after which the patient returned to work.

RECURRENT KERATOCONJUNCTIVITIS WITH PANNUS OF THE LEFT EYE; CONJUNCTIVITIS WITH THICKENING AT THE LIMBUS OF THE RIGHT EYE. DR. CONRAD BERENS.

A white woman aged 31 was first seen in October 1929 complaining of redness and burning of the eyes for the past seven months. The vision at that time was 20/50 — in the right eye and 10/200 in the left

eye. This could be corrected to 20/20 in each eye. Examination showed bilateral conjunctivitis with follicular enlargement and in the left eye a pannus extending 4.5 mm. onto the cornea from above. There was no involvement of the conjunctiva of the upper fornix. Examination of conjunctival scrapings on one occasion showed suspicious but not typical inclusion bodies.

Complete medical studies made shortly after the patient's first visit showed nothing of significance. Cultures of the nose, throat and feces showed the organisms commonly found in these locations.

Since 1929 the process has continued, with intermittent remissions and recurrences; the pannus in the left eye extended to involve the cornea from below and cover the pupillary area. There have been several attacks of superficial punctate keratitis and conjunctivitis of the right eye with thickening of the conjunctiva at the limbus below, but no pannus has developed. At the time of this report the vision is 20/20 — in the right eye and 10/200 in the left eye.

Many diagnoses have been made for this patient's condition, among them the following: Fuchs in 1930 considered it to be a manifestation of a delayed phlyctenular conjunctivitis. Wilmer regarded it to be due to an existing toxemia, and Dwyer considered it as possibly due to vitamin deficiency.

In the time the patient has been under treatment the only positive findings of possible significance have been: (1) a basal metabolic rate of — 20 in 1934; (2) sensitivity to several foods, dusts and feathers; (3) congestion of the turbinates; (4) the presence of Streptococcus viridans and Staphylococcus albus in cultures of material from the nose and throat and (5) tuberculin sensitivity.

Treatments have been continuous and varied. They include the administration of an autogenous vaccine, a diet high in vitamins, a diet eliminating foods to which the patient was sensitive (she could notice no difference), cauterization of the cornea twice with the Prince cautery, the administration of tuberculin for one year, ultraviolet irradiation, vitamin therapy, injections of the patient's own blood, the administration of sulfanilamide, the injection of a toxic antigen made from the nose and throat cultures and grenz irradiation.

So far there has been nothing which has been of lasting benefit or has served to check the progress of the disease, although the lesions have disappeared spontaneously on several occasions when the patient rested. The patient's vision and efficiency have been impaired, and there seems to be beginning involvement of the right cornea.

Because the condition has existed for nine years and the second eye is becoming involved, in spite of treatment by competent general physicians and ophthalmologists, the case is reported for diagnosis and suggestions for treatment.

A test made for undulant fever was reported to be negative. No viruses were found in the patient's nasal secretions.

RETINITIS STRIATA. DR. OLGA SITCHEVSKA.

A man aged 36 had peculiar white yellowish lines in the retina of the right eye. They were situated beneath the retinal vessels, were of various widths and were studded in some places with pigment. They

were present below and above the disk, branching and extending toward the extreme periphery. The line below the disk terminated in an old choroidal patch at the extreme lower nasal quadrant.

Vision in the right eye could be corrected only to 20/50 because of changes in the lens and the opacities of the vitreous. Oatman reported a similar case in which he made a diagnosis of retinitis striata. I have accepted the same diagnosis in this case and believe that some inflammatory process took place in early infancy in both the choroid and the retina and caused these changes.

BILATERAL SYMMETRIC CYSTOID DETACHMENT OF THE RETINA. DR. A. L. KORNZWEIG.

A white man aged 33 had marked compound hyperopic astigmatism and exophoria of high degree. The best vision with correction was 20/40 in the right eye and 20/70 in the left eye. Routine examination of the fundi showed symmetric cystoid detachment of the retinas, situated in the extreme periphery at 6 o'clock. The margin of the detachment was sharp and spherical in outline; its surface was slightly roughened and pitted, comparable to the surface of an orange. There were several white lines on the surface of the elevation in the right eye and the termination of a retinal vessel in the left eye. When looked at directly, the surfaces of the detached retinas were so transparent that the choroidal vessels could be seen and the margin became so faint as to be almost lost. By indirect light the details were brought out much better.

I reviewed the literature and found a similar but not identical case described by Professor Weve, of Utrecht, Netherlands. Such cysts are believed to be congenital and due to folds of the retinal layer of the secondary optic vesicle. The folds are found especially in hyperopic or small eyes.

(Photographs of the fundi in color were shown.)

DISCUSSION

DR. MORRIS DAVIDSON: I have seen a similar case, in which the condition was also bilateral and symmetric. However, the cysts were situated in the upper temporal region of the fundus. Apparently the cysts had ruptured, since there was pigment in the vitreous.

PARALYSIS OF THE MUSCLES IN EXOPHTHALMIC GOITER. DR. SAUL MILLER.

Paralysis of individual muscles occurred in a patient several months after thyroidectomy for exophthalmic goiter. There was practically no exophthalmos. Marked diplopia, which invalided the patient, was reduced to such an extent by resection of the paralyzed muscle that after correction with glasses she was able to resume her daily duties. Pathologic examination of the excised muscle revealed atrophy of muscle tissue without lymphorrhagia.

DISCUSSION

DR. PERCY FRIDENBERG: Some of the symptoms Dr. Miller described suggest that the condition is an incomplete paralysis of upward gaze rather than a muscular condition. Recently attention has been called to the fact that any and all of the classic ophthalmologic symptoms of exophthalmic goiter, bearing the names of Graefe, Stellwag, Moebius

and others, may be seen either singly or combined, sometimes coming on singly and remaining singly or later being added to by other symptoms of disease of the midbrain. The theory has been advanced that when these symptoms occur in exophthalmic goiter, they are not directly due to hypertrophy or excess hormone secretion of the thyroid so much as to the direct involvement of the midbrain, which controls the upper part of the face or the so-called muscles of facial expression; in other words, the condition is a disease of the midbrain due to the dysfunction of the thyroid, or there may be direct local lesions in the midbrain indirectly affecting the thyroid, because similar symptoms have been seen in diseases of the midbrain, such as epidemic encephalitis and, as in this case, in exophthalmic goiter alone. It would be interesting to know if there are any other symptoms which would point to involvement of the midbrain, short, of course, of encephalitis.

DR. SAUL MILLER: In regard to paralysis of upward gaze as I understand it, one would not find diplopia in various positions when testing the muscles, as this case showed.

In reference to the neurologic examination, which was done completely on several occasions, the results were always negative.

The other point I want to bring out is that this muscle is atrophic and does not show any signs of lymphorrhagia.

DR. PERCY FRIDENBERG: The atrophic condition of the muscle would seem to settle the question, but if an incomplete paralysis of upward gaze is being dealt with and if that paralysis is unequal in the two eyes, I think one could well expect diplopia.

CYST IN THE VITREOUS. DR. FRANK LA GATTUTA.

A well developed Negro girl, aged 14 years, was first seen at the ophthalmic clinic of the Morrisania Hospital on Jan. 4, 1935. Her chief complaints were black spots and lines before the left eye and blurred vision of the same eye for the past eight months. The family and past histories were irrelevant. The visual acuity of the right eye was 20/20 —, and that of the left eye was limited to perception and projection of light. The external ocular examination gave negative results, and the pupillary reflexes were normal. Examination of the fundus of the left eye under cycloplegia with a 2 per cent solution of homatropine hydrobromide revealed slight blurring of margins of the disk. A grayish white mass of diffuse proliferating tissue was seen to arise from the center of the disk, covering its entire temporal half; it appeared to flare forward and temporally involved the macular region. It contained one large distended vein and several small wavy arteries. The vitreous was clear; transillumination was reduced in the temporal region; the tension was 25 mm. of mercury (McLean). Weekly examinations revealed a gradual shrinking of the mass. On March 15 the mass became well demarcated, more grayish and pear shaped and lay horizontally. It had lost its vascularity and assumed the appearance of a cyst. Two weeks later the vision in the left eye improved to ability to distinguish fingers at 1 foot (30 cm.). A small hemorrhage was seen on the disk in the region of 8 o'clock. The disk appeared edematous, with distended veins and tortuous arteries. The mass now appeared

like a gourd, the neck arising from the center of the disk and its body covering the macula. Arising from the lower portion of this gourdlike cyst was a grayish white offshoot (fishbone in shape), which swept downward and temporally for a distance of 3 disk diameters.

On June 21 the vision in the left eye increased to ability to distinguish fingers at 3 feet (91 cm.), and a definite divergent squint appeared. During the succeeding months and years this cystic mass shrunk progressively until April 29, 1938, when it assumed the shape of the upper half of a drum major's baton with a small spur at its head. It was glistening white. A definite area of macular choroidal degeneration now became apparent. Vision in the left eye remained limited to ability to distinguish figures at 1 foot. Up to the time of this report this picture has

A cyst in the vitreous of the left eye.

not undergone any appreciable change. Frequent tonometric readings varied from 25 to 30 mm. of mercury (McLean).

The history, course of events and findings point to some inflammatory disease of the disk, causing rapid loss of vision, while the resulting fibrosis produced a cystic mass, exposing an area of macular degeneration probably resulting from atrophy.

OPTIC NEURITIS OF RHINOGENOUS ORIGIN IN A CHILD. DR. M. JAFFE.

This case is presented for two reasons: First, the role of infection of the paranasal sinuses in the causation of retrobulbar neuritis is completely denied, at least in some quarters; and second, the condition is rare in children.

The patient was a well nourished child 12 years of age. When he was examined on Dec. 16, 1938, there was no evidence of an extraocular

or an intraocular pathologic process with the exception of an error of refraction. Vision equaled 20/20 in each eye. On his second visit on Jan. 7, 1939, he complained of defective vision in left eye of four days' duration. The onset apparently was sudden, without pain. There was no diplopia.

Physical examination revealed no evidence of acute or chronic diseases, with the exception of residue of a recent infection of the upper part of the respiratory tract. There was some tenderness over the sinuses on the left side. There was a marked deviation of the nasal septum, both to the right and to the left, with significant obstruction to breathing. External ocular examination gave negative results. The left pupil was wider than the right but reacted actively to light. The right fundus was normal in every respect. The left fundus showed edema of the papilla, particularly below, where there was also a widespread exudate, extending toward the macula. The veins were engorged, and there were a few striate linear hemorrhages near and on the swollen optic disk. There was no disturbance of the peripheral field for form. There was no central scotoma, but there was a fan-shaped pericentral scotoma above the point of fixation, between the 40 and 180 degree meridians, extending between the 5 and 20 degree isopters. The vision in the right eye was 20/20 — 4; with correction, it was 20/20. Vision in left eye was 20/30 — 2. On account of the pericentral scotoma, objects were not sharply outlined as with the right eye. The neurologic findings were entirely normal. The Wassermann reaction of the blood was negative. A roentgenogram showed marked ethmoiditis on the left, and less marked antritis on the right.

This unilateral optic neuritis may be the initial symptom of multiple sclerosis, which will manifest itself in the future. However, without any other etiologic factors to account for the involvement of the optic nerve and with such definite evidence of infection of the paranasal sinuses, one is inclined to believe that the ocular manifestation is associated with the rhinogenous infection. There has been considerable recession of the papilledema under treatment directed by a rhinologist. No operative treatment was resorted to because considerable reconstructive surgical work was required and because of the response to conservative treatment of the nose and to injections of nonspecific protein.

From anatomic studies, it is known that the posterior ethmoid cells and the sphenoid sinus influence the size and shape of the optic canal to some extent. A sphenoid sinus which is enlarged superiorly and externally may come in such contact with the optic canal that an indentation of the canal occurs. Closer contact may result in a dehiscence of the bone covering the optic nerve, so that it is in close contact with the mucous membrane of the sinus. Such close contact of the sinuses and optic canal is rare, yet it does exist, as shown by numerous anatomic demonstrations. The optic neuritis is brought about either by direct pressure mechanically or through collateral edema. Different grades of optic neuritis may be observed, depending on the following factors: the degree of infection or actual empyema with the resultant gaseous decomposition and the degree of proximity of the optic

canals. Because of the close association of the arterial, venous and lymphatic circulation of the posterior sinuses and orbital structures, toxic invasion, inflammatory swelling, thrombophlebitis or anaphylaxis from a focus of infection are possible means of involvement of the optic nerve.

In early childhood the paranasal sinuses are poorly developed. This accounts for the extreme rarity of optic neuritis in the young. Yet the unusual anatomic relation of the posterior ethmoid cells and of the sphenoid sinus to the optic canal as described in the adult may prevail in the young as well. Hence, retrobulbar neuritis in the young, while rare, is not at all impossible.

Book Reviews

Corteza visual. Estudio filogenetico. By Flaminio Vidal and Baudilio Courtis. From the Institute of Psychiatric Clinic, University of Buenos Aires. Pp. 308, with 30 original photographs. Buenos Aires: Aniceto Lopez, 1938.

The authors have made a rather exhaustive study of the visual cortex by comparing the human brain with the brains of lower forms of life (vertebrates and invertebrates). It is interesting to note that they use the brains of persons with dementia paralytica, dementia melancholia, arteriosclerosis and dementia praecox. After a rather careful description of the visual cortex in the aforementioned brains, they present an illustrated study of the brain of the chimpanzee, then proceed down the scale to include the brains of invertebrates.

The monograph is well illustrated with pictures of the brain to demonstrate the convolutions of the visual cortex and its boundary, a comparative study of relief and regional variations being stressed. This work represents an exhaustive study, really a specialized study, of comparative anatomy, and while one finds little in the book that reveals anything new, it is extremely interesting and is comprehensively arranged.

The authors' conclusions are well drawn and interesting. They point out that as the visual lobes, or the visual cortex, in man show a more marked development than in the lower animals, a more highly integrated function of the visual cortex is probably indicated. They also point out that there is an equality of the two visual lobes in man and that there is evident parallelism between the development of the visual lobes and a higher development of the visual sense.

That the deeper convolutions evidence a higher mental and visual state in man than in the lower animals was a rather interesting observation; but this, again, is not a new conception. The authors conclude their summary by saying that one might well make a zoologic classification of man and the lower animals on the basis of cerebral morphology. This is probably correct.

We are wondering just what their opinion might be of the fact that the hawk and the chamelion present histologic evidence of a more highly developed visual acuity than man.

This work of the Argentinean authors merits study and consideration from any one who is interested in a comparative anatomic study of the visual cortex. It is interesting and enlightening.

C. Ray Franklin.

M. U. Troncoso.

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Time: July 6-8, 1939.

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PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. J. Edward Clark, 1305–14th Ave., Seattle.
Secretary-Treasurer: Dr. Purman Dorman, 1115 Terry Ave., Seattle.
Place: Seattle or Tacoma, Wash. Time: Third Tuesday of each month, except June, July and August.

ROCK RIVER VALLEY EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. L. J. Friend, 425 E. Grand Ave., Beloit, Wis.
Secretary-Treasurer: Dr. Thorsten E. Blomberg, 501–7th St., Rockford, Ill.
Place: Rockford, Ill., or Janesville or Beloit, Wis. Time: Third Tuesday of each month from October to April, inclusive.

SAGINAW VALLEY ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Don M. Howell, Alma, Mich.
Secretary-Treasurer: Dr. Louis D. Gomon, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. R. A. Kelly, 304 N. Main St., Mitchell, S. D.
Secretary-Treasurer: Dr. J. C. Decker, 515 Frances Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Grady E. Clay, Medical Arts Bldg., Atlanta, Ga.
Secretary: Dr. John R. Hume, 921 Canal St., New Orleans.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. Carl Wencke, Battle Creek.
Secretary-Treasurer: Dr. A. K. Zinn, Battle Creek.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. C. M. Harris, Johnstown.
Secretary-Treasurer: Dr. C. Wearne Beals, 41 N. Brady St., DuBois.

STATE

COLORADO OPHTHALMOLOGICAL SOCIETY

President: Dr. Melville Black, 424 Metropolitan Bldg., Denver.
Secretary: Dr. John C. Long, 324 Metropolitan Bldg., Denver.
Place: University Club, Denver. Time: 7:30 p. m., third Saturday of each month, October to May, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. William M. Good, 63 Center St., Waterbury.
Secretary-Treasurer: Dr. S. J. Silverberg, 201 Park St., New Haven.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. Grady E. Clay, 384 Peachtree St. N. E., Atlanta.
Secretary-Treasurer: Dr. J. Mason Baird, 511 Medical Arts Bldg., Atlanta.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Marlow W. Manion, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Edwin W. Dyar Jr., 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: First Wednesday in April.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. H. Lamb, American Bank Bldg., Davenport.
Secretary-Treasurer: Dr. B. M. Merkel, 604 Locust St., Des Moines.
Place: Davenport.

LOUISIANA-MISSISSIPPI OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. D. C. Montgomery, 301 Washington Ave., Greenville, Miss.
Secretary-Treasurer: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. B. Fralick, 201 S. Main St., Ann Arbor.
Secretary: Dr. O. McGillicuddy, 124 W. Allegan St., Lansing.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Frank N. Knapp, 318 W. Superior St., Duluth.
Secretary-Treasurer: Dr. George E. McGeary, 920 Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. Roy Grigg, Bozeman.
Secretary: Dr. A. W. Morse, 507 Phoenix Bldg., Butte.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. Norman W. Burritt, 30 Beechwood Rd., Summit.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION
Chairman: Dr. Algernon B. Reese, 73 E. 71st St., New York.
Secretary: Dr. Chester C. Cott, 333 Linwood Ave., Buffalo.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY
President: Dr. F. C. Smith, 106 W. 7th St., Charlotte.
Secretary-Treasurer: Dr. M. R. Gibson, Professional Bldg., Raleigh.
Place: Statesville: Time: Sept. 21, 1939.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY
President: Dr. N. A. Youngs, 322 De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, 516–6th St., Valley City.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY
President: Dr. L. O. Clement, 406 State St., Salem.
Secretary-Treasurer: Dr. Paul Bailey, 833 S. W. 11th Ave., Portland.
Place: Good Samaritan Hospital, Portland. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY
Acting President: Dr. N. Darrell Harvey, 112 Waterman St., Providence.
Secretary-Treasurer: Dr. Linley C. Happ, 124 Waterman St., Providence.
Place: Rhode Island Medical Society Library, Providence. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY
President: Dr. S. B. Fishburne, 1430 Marion St., Columbia.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY
President: Dr. J. B. Stanford, 899 Madison Ave., Memphis.
Secretary-Treasurer: Dr. W. D. Stinson, 124 Physicians and Surgeons Bldg., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY
President: Dr. A. N. Champion, 705 E. Houston St., San Antonio.
Secretary: Dr. Dan Brannin, 1719 Pacific Ave., Dallas.
Place: Houston. Time: December 1939.

UTAH OPHTHALMOLOGICAL SOCIETY
President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY
President: Dr. Charles T. St. Clair, 418 Bland St., Bluefield, W. Va.
Secretary-Treasurer: Dr. M. H. Williams, 30½ Franklin Rd. S. W., Roanoke.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION
President: Dr. George Traugh, 309 Cleveland Ave., Fairmont.
Secretary: Dr. Welch England, 621½ Market St., Parkersburg.

LOCAL

AKRON ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY
President: Dr. L. E. Brown, Second National Bldg., Akron, Ohio.
Secretary-Treasurer: Dr. C. R. Anderson, 106 S. Main St., Akron, Ohio.
Time: First Monday in January, March, May and November.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. Arthur G. Fort, 478 Peachtree St. N. E., Atlanta, Ga.
Secretary: Dr. Lester A. Brown, 478 Peachtree St. N. E., Atlanta, Ga.
Place: Grady Hospital. Time: 6:00 p. m., second Wednesday of each month from October to May.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Frank B. Walsh, Wilmer Institute, Johns Hopkins Hospital, Baltimore.
Secretary: Dr. Fred M. Reese, 6 E. Eager St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Birmingham Eye, Ear, Nose and Throat Club

President: Each member, in alphabetical order.
Secretary: Dr. N. E. Miles, 408 Medical Arts Bldg., Birmingham, Ala.
Place: Tutwiler Hotel. Time: 6:30 p. m., second Tuesday of each month, September to May, inclusive.

Brooklyn Ophthalmological Society

President: Dr. E. Clifford Place, 59 Livingston St., Brooklyn.
Secretary-Treasurer: Dr. Frank Mallon, 1135 Park Pl., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. James G. Fowler, 412 Linwood Ave., Buffalo.
Secretary-Treasurer: Dr. Sheldon B. Freeman, 196 Linwood Ave., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. A. H. Benz, 706 Medical Arts Bldg., Chattanooga, Tenn.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Georgiana Dvorak-Theobald, 715 Lake St., Oak Park, Ill.
Secretary-Treasurer: Dr. Earle B. Fowler, 55 E. Washington St., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati Ophthalmic Club

Chairman: Each member, in rotation.
Secretary-Treasurer: Dr. E. R. Thomas, 819 Carew Tower, Cincinnati.
Place: Holmes Memorial Library, Cincinnati General Hospital. Time: 8:15 p. m., third Monday of each month except June, July and August.

Cleveland Ophthalmologic Club

Chairman: Dr. Albert J. Ruedemann, Cleveland Clinic, Cleveland.
Secretary: Dr. G. Leslie Miller, 14805 Detroit Ave., Cleveland.
Time: Second Tuesday in October, December, February and April.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Clerk: Dr. W. S. Reese, 1901 Walnut St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

COLUMBUS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

Chairman: Dr. Hugh G. Beatty, 150 E. Broad St., Columbus, Ohio.
Secretary-Treasurer: Dr. W. A. Stoutenborough, 21 E. State St., Columbus, Ohio.
Place: Deshler Wallick Hotel. Time: 6 p. m., first Monday of each month.

CORPUS CHRISTI EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. Edgar G. Mathis, 416 Chaparral St., Corpus Christi, Texas.
Secretary: Dr. E. King Gill, 416 Chaparral St., Corpus Christi, Texas.
Time: Second Thursday of each month from October to May.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Maxwell Thomas, Medical Arts Bldg., Dallas, Texas.
Secretary: Dr. J. Dudley Singleton, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DES MOINES ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month from September to May.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. Arthur S. Hale, 1609 Eaton Tower, Detroit.
Time: 6:30 p. m., first Wednesday of each month.

EASTERN NEW YORK EYE, EAR, NOSE AND THROAT ASSOCIATION

President: Dr. L. A. Hulsebosch, 191 Glen St., Glen Falls.
Secretary-Treasurer: Dr. Joseph L. Holohan, 330 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. R. A. Gough, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Charles R. Lees, 806 Medical Arts Bldg., Fort Worth, Texas.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

GRAND RAPIDS EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Dewey R. Heetderks, 405 Medical Arts Bldg., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 116 E. Fulton St., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. Louis Daily, 1215 Walker Ave., Houston, Texas.
Secretary: Dr. Herbert H. Harris, 1004 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. C. W. Rutherford, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: Indianapolis Athletic Club. Time: 6:30 p. m., second Thursday of each month from November to June.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. E. N. Robertson, Concordia, Kan.
Secretary: Dr. John S. Knight, 1103 Grand Ave., Kansas City, Mo.
Time: Third Thursday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Ben K. Parks, 619 Professional Bldg., Long Beach, Calif.
Secretary-Treasurer: Dr. Paul Nilsson, 211 Cherry Ave., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Otolaryngology

President: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Secretary-Treasurer: Dr. John P. Lordan, 2007 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:00 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. Gaylord C. Hall, Brown Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. Charles K. Beck, Starks Bldg., Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Earle Breeding, 1801 I St. N. W., Washington.
Secretary: Dr. Elmer Shepherd, 1606–20th St. N. W., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. Sam H. Sonders, Medical Arts Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. John E. Mulsow, 231 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. John B. Hitz, 411 E. Mason St., Milwaukee.
Place: University Club. Time: 6:30 p. m., second Tuesday of each month.

Minneapolis Ophthalmological Society

Chairman: Each member, in alphabetical order.
Secretary: Dr. M. C. Pfunder, 645 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

Montgomery County Medical Society

Chairman: Dr. H. V. Dutrow, 1040 Fidelity Medical Bldg., Dayton, Ohio.
Secretary-Treasurer: Dr. Maitland D. Place, 981 Reibold Bldg., Dayton, Ohio.
Place: Van Cleve Hotel. Time: 6:30 p. m., first Tuesday of each month from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. L. de G. Joubert, 690 Dunlop St., Montreal, Canada.
Secretary: Dr. K. B. Johnston, 1509 Sherbrooke St. W., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Guy Maness, 119–7th Ave., Nashville, Tenn.
Secretary-Treasurer: Dr. Andrew Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to May.

NEW HAVEN OPHTHALMOLOGICAL SOCIETY

President: Dr. Eugene M. Blake, 303 Whitney Ave., New Haven, Conn.
Secretary: Dr. Frederick A. Wies, 255 Bradley St., New Haven, Conn.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. E. G. Walls, 619 Maison Blanche Bldg., New Orleans.
Secretary-Treasurer: Dr. W. B. Clark, 1012 American Bank Bldg., New Orleans.
Place: Louisiana State University Medical Bldg. Time: 8 p. m., second Tuesday of each month from October to June.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. James W. White, 15 Park Ave., New York.
Secretary: Dr. Rudolf Aebli, 30 E. 40th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

President: Dr. Percy Fridenberg, 38 W. 59th St., New York.
Secretary: Dr. David Alperin, 889 Park Pl., Brooklyn.
Place: Squibb Hall, 745–5th Ave. Time: 8 p. m., first Monday of each month from October to May, inclusive.

OMAHA AND COUNCIL BLUFFS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. J. T. Maxwell, 1140 Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

OPHTHALMOLOGICAL SOCIETY OF THE UNIVERSITY OF PITTSBURGH

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, 351–5th Ave., Pittsburgh.
Time: Second Monday in November, January, March and May.

PASSAIC-BERGEN OPHTHALMOLOGICAL CLUB

President: Dr. R. N. Berke, 430 Union St., Hackensack, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 340 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

PHILADELPHIA COUNTY MEDICAL SOCIETY, EYE SECTION

Chairman: Dr. Walter I. Lillie, 255 S. 17th St., Philadelphia.
Secretary: Dr. Edmund B. Spaeth, 1930 Chestnut St., Philadelphia.
Time: First Thursday of each month from October to May.

PITTSBURGH OPHTHALMOLOGICAL SOCIETY

President: Dr. Edward Stieren, Union Trust Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, 351–5th Ave., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

RICHMOND OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Rudolph Thomason, Professional Bldg., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. Edwin S. Ingersoll, 26 S. Goodman St., Rochester, N. Y.
Secretary-Treasurer: Dr. Charles T. Sullivan, 277 Alexander St., Rochester, N. Y.
Place: Rochester Academy of Medicine, 1441 East Ave. Time: 8 p. m., second Wednesday of each month from September to May.

St. Louis Ophthalmic Society

President: Dr. B. Y. Alvis, Carleton Bldg., St. Louis.
Secretary: Dr. Carl C. Beisbarth, 3720 Washington Blvd., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Oscar H. Judkins, 414 Navarro St., San Antonio, Texas.
Secretary-Treasurer: Dr. Wilfred E. Muldoon, 414 Navarro St., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Russell Fletcher, 490 Post St., San Francisco.
Secretary: Dr. Avery Morley Hicks, 490 Post St., San Francisco.
Place: Society's Bldg., 2180 Washington St., San Francisco. Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. R. R. Kirkpatrick, 6th and Walnut Sts., Texarkana, Ark.
Secretary-Treasurer: Dr. W. L. Atkins, 940 Margaret Pl., Shreveport, La.
Place: Shreveport Charity Hospital. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. P. B. Greene, 422 Riverside Ave., Spokane, Wash.
Secretary: Dr. O. M. Rott, 421 Riverside Ave., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. James F. Cahill, 428 S. Salina St., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. Herbert Katz, 713 E. Genesee St., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. A. Lloyd Morgan, 170 St. George St., Toronto, Canada.
Secretary: Dr. W. R. F. Luke, 170 St. George St., Toronto, Canada.
Place: Academy of Medicine, 13 Queens Park. Time: First Monday of each month, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. Ernest Sheppard, 927 Farragut Sq. N. W., Washington, D. C.
Secretary-Treasurer: Dr. E. Leonard Goodman, 1801 I St. N. W., Washington, D. C.
Place: Episcopal Eye and Ear Hospital. Time: 7:30 p. m., first Monday in November, January, March and April.